Simple Solar Homesteading

Off the Grid

by LaMar Alexander

This book is for anyone that lives off-grid or would like to live an off-grid homesteader lifestyle.

It includes many complete step-by-step plans, pictures, and material list for building an off-grid cabin and over 30 useful homestead projects.

Also included are directions for installing a small solar and wind power system, rain water harvest system, composting toilet, and much more...

In this book you will learn:

1. **How to build a 14x14 solar cabin for under $2000**
2. **How to build cabin additions for more room**
3. **How to install a small solar and wind power system**
4. **How to build a solar composting toilet**
5. **How to drill a well and harvest rain and gray water**
6. **How to install a wood stove and build an outdoor wood furnace**
7. **How to build chicken tractors and rabbit pens**
8. **How to make your homestead sustainable with animals raising and gardening**
9. **How to make a good living from your homestead**

Plus- plans for hand washing machine, solarium, pallet hot tub, sport trailer and more.
Plus- guide to many different unique homes like strawbale, container, log, dome, etc.
Plus- how to find cheap homesteading land and resource guide
Plus- 3D Cabin modifiable files to design your own solar cabin

LaMar Alexander is an off-grid homesteader and Health Education Specialist that has dedicated his life to helping people to live simply. He lives in his solar cabin at the foot of the Uintah mountains and has written many books on cabin building, solar power and survival shelters.

"Our life is frittered away by detail. Simplify, simplify. "
-Henry David Thoreau

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INTRODUCTION

Hello folks, My name is LaMar Alexander and this is my book. I have always been interested in homesteading and solar power from the time I was a young boy. I grew up on my parents homestead which was passed down to my father from his father and is where I now live. This old homestead was built by people that knew how to live self sufficiently, not because it was a trendy thing to do, but because it was necessary to survive.

My grandparents raised 11 children and my parents raised 9 children through 3 wars and the great depression. Homemade clothes, preserved food, gardening, and farming skills is what kept us all alive.

I became interested in solar power as a teen reading through my brothers Mother Earth News and Organic Gardening magazines. I was intrigued by how powerful the sun could be and how it could be easily harnessed to do work. Back then solar panels were just for the very rich but I did build a simple green house with my father and brothers and we learned to use hot caps and cold frames to extend growing seasons.

As I got older I wanted my own place so I rebuilt an old cabin that was on my fathers place and that started my interest in building simple small cabins to live in. I just couldn't understand, and still don't, why people would want to build big expensive homes that are hard to heat and cool and waste so many resources ?

I went away to college where I studied architectural and mechanical drafting for 2 years before deciding I wanted to be a teacher. I chose Health and Safety education for my specialty because I enjoyed helping others to be safe and healthy. I worked for several years as a risk manager for Utah State University and as a volunteer instructor for the American Red Cross where I served as the Health and Safety Services Director for all of Cache County. I spent another 10 years teaching health and safety classes in residential treatment programs for troubled teens. These experiences were excellent in shaping my beliefs that people want and need simple safe and healthy homes to be happy.

In 1989 I was faced with a life altering situation. I became ill and no longer able to pursue my teaching career. This resulted in depression and anxiety and the end result was a divorce and loss of my career and most everything I had worked for. I had hit bottom as they say, but luckily someone was there to put me back on the simple track again. That someone gave me a Mother Earth News magazine to read. I hadn't seen one in 15 years and I was immediately thrilled with all the new solar technology and ideas people had for living simply. This was what I wanted and needed, to get back to a simple homesteading way of life that allowed me to be self-sufficient and function within the restrictions of my physical limitations.

I still owned 1 acre of land my parents left me on the old homestead and with what little money I had, a bag full of clothes and an old car and I headed back to start my new simple homestead. I needed shelter fast so I designed a simple sturdy cabin that I could build by myself with locally available materials for under $2000.

There was no electricity on my property and it was too expensive to have brought in so solar power and a generator power system was my next project. I needed a septic system but didn't want to dig up a lot of ground for drain fields so opted for a solar composting toilet of my own design.

There was a water well near by but I wanted to be self sufficient so I also designed a rain water and grey water recycling system. There was good soil to grow a garden so I designed a solar green house for food and solarium to help heat my cabin in winter. I decided to keep everything simple so a solar dish washer, clothes washer, and dryer took care of my cleaning needs.

I didn't just rush in and build these things, I did study other peoples ideas and then adapted and changed them for simplicity to meet my needs. I tried to keep everything simple and inexpensive so I could replace or duplicate it if needed. As I was building my projects I kept a journal and took pictures for my own future needs and because I thought someday someone else might want to start a simple homestead and could benefit from my experiences. Well that day has arrived!

I have reached the point in my life where I see a real need for people to get back to a simpler, safer and healthier way of life and I hope by sharing my plans and stories I can help others to achieve that better life. All the talk about global warming, housing market crash, Katrina damage and future over-population and pollution problems has made me a firm believer that if mankind is to survive we must simplify our lives and reduce the impact we are having on our planet.

My designs for a simple homestead can be duplicated by anyone with a small amount of money, limited time and basic building skills.

I believe with all my heart that my life is much better and healthier because of my homestead lifestyle and I believe you will be happier, healthier and safer if you will simplify your life using just some or all of the ideas presented in this book.

Peace, and may the sun always shine on your cabin!

LaMar

The Modern Thoreau

Before you begin reading this book I would like to introduce you to my Inspiration, a man named Henry David Thoreau. He was not the first homesteader by any means but the first to document his journey in homesteading in his book Walden which I highly recommend and is now available free:

Walden By Henry David Thoreau

Thoreau was an eccentric even for his time and refused to follow the lifestyle of his family, neighbors and friends instead choosing to build his life from scratch based on the basic principles that everything must be boiled down to its very simplest nature including shelter, food, comfort, and social interactions.

He eschewed the idea that a fancy house, money, or expensive trappings made you a better person, more educated, or more worthy. In his writings he teaches that through simplifying your life you become more in tune with your own nature, thoughts and feelings that are suppressed by the hustle and bustle demands of the rat race most people live everyday.

Many of the most famous artists, musicians, writers, inventors and philosophers have followed those same principles to move themselves away from the mainstream in order to as they say "find themselves" and inspire their creativity.

So with that in mind- as you read through this book I hope you will see not only plans for projects but a foundation for a lifestyle built on simplicity.

It is not a lifestyle that will appeal to everyone but I would hope that it appeals to people like Thoreau and myself and you that dance to a different drummer. If you are expecting highly technical engineered drawings or complicated systems approved for all locations and codes you will probably be disappointed. This book is about simplifying life not making it more complicated.

However, if you are interested in having a simple life with no house payments and no utility bills so that you can spend your time and money on other pursuits besides working as another rat in the race then I hope you will be inspired by this book to take the leap.

If your only interest is to build a vacation cabin or guest house and learn about basic solar projects then this book should serve you well. If you are serious about living a simple off grid lifestyle then I hope I have included enough information to ease you over your fears and inspire you to make your dreams a reality.

Unlike Thoreau, I am a modern homesteader and I do rely on some modern devices to make my life simpler. I have TV, Internet and Cell Phone in my cabin and electric lights, propane, refrigeration, and indoor plumbing. I think Thoreau would approve.

I have now been off-grid living a very simple life for almost 15 years and I can tell you with all honesty and candor that most of the time I love it, when things don't work the way I planned I may hate it for a minute, but I would never ever trade my life for all the gold and titles in the world!

"Our life is frittered away by detail. Simplify, simplify. "
-Henry David Thoreau

How to build
a sturdy solar cabin
for under $2000

NOTICE: These plans are for a shed like structure that sits on unsecured deck block which may not be suitable for all locations especially in areas where tornadoes or extremely high winds are prevalent or on unstable ground. Consult with your local building agent or architect before building in these areas please.

TOOLS NEEDED: I used power tools but hand tools would work just fine. You need a saw, hammer, screw driver, drill, bubble level, tape measure, square, 6 foot ladder and extension ladder. If you do not have power on your property a small generator can be used to run power tools.

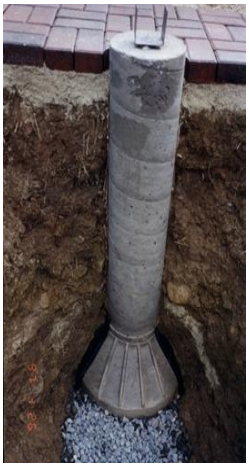
TIME REQUIRED:
I built my cabin completely by myself from start to finish in two weeks. I worked about 4 hours a day on weekdays and about 8 hours on weekends so figure about 80 to 100 hours total time. This could have been greatly reduced with two or more people working together!

APPROXIMATE COST: I built this cabin from all new materials at a cost of less than $2000 (excluding windows, doors, and deck). You can use recycled material to save money or better material if you desire. I support our local small business people by buying directly from the small lumber mills and mom and pop hardware stores. The windows are double pane low e-glass and the doors are steel insulated which I got for nothing from a trailer that was being demolished. Use the best doors and windows you can find as they are real heat robbers if done cheaply! There is a material list at the end of the plans.

SKILL REQUIRED: If you have used power tools and built a shed or dog house you can probably handle this project. If you are not sure of you ability then please get help from someone with building experience

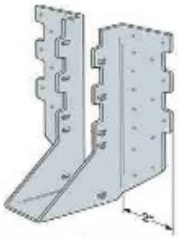
Foundation supplies:

Concrete Deck Block accepts 4x4 post

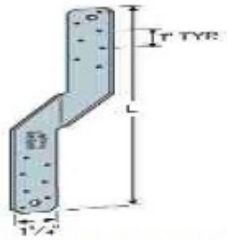


Pier tube with 4x4 post hanger

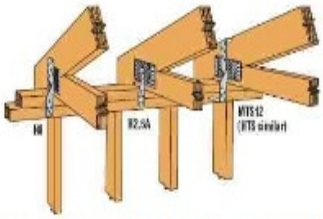
Joist Hangers and Steel Connectors:



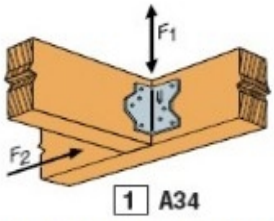
JOIST HANGERS - 316 Stainless Steel



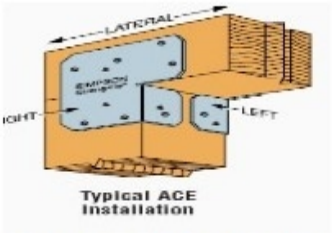
TWIST & STRAIGHT CONNECTOR STRAPS - STAINLESS



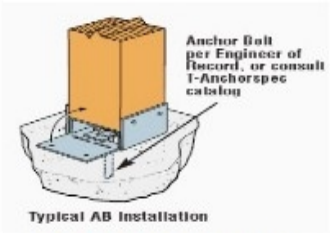
HURRICANE TIES & STRAPS - Stainless Steel



FRAMING ANGLES - STAINLESS STEEL



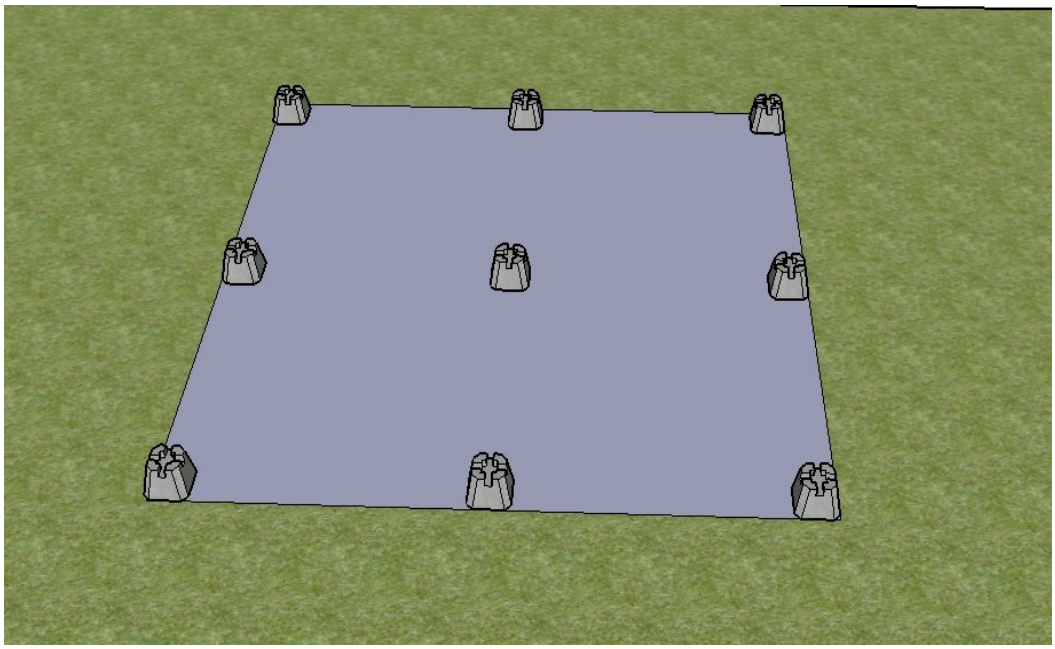
POST CAPS - STAINLESS STEEL



POST & COLUMN BASES

Picture courtesy of http://shop1.mailordercentral.com/marshfasteners

Foundation Lay Out:



Black Plastic laid on ground for radon and weed barrier

STEP #1: pick a location

If you have your property already then you have probably picked a spot for the cabin. But before you start building I would offer this advice. The prettiest site near the river or high on the hill may not be your best place to build. Pick a spot that is protected from wind and flooding but gives you full southern exposure so you can take advantage of the solar features of your cabin.

For your foundation you will need 6 deck blocks that accept a 4 x 4 post available from your lumber store or any place that sells lumber for decks. If you want a permanent foundation then use pier tubes and concrete poured below the frost line and a 4x4 deck post pier. For these plans we will use the deck blocks.

Place the deck blocks on firm ground. If necessary, tamp the earth down solid with a big heavy log. You will need (5) 2 x 6 x 14 pine boards and (4) 2 x 6 corner braces for the frame. Screw the frame together with the mounting braces and place the frame on the deck blocks as shown here.

Now square your frame by taking a piece of string and a tack and place the string from one corner to the other cross corner. Mark where the string comes to the corner. Then do the same thing on the opposite corners. You will have to move corners in or out until you get a perfectly squared frame also adjust the deck block so they are directly under the frame corners ready for the 4x4s. If you skip squaring the frame your wall and roof panels will not fit without lots of trimming and waste so take the time to do this step correctly.

Step #2: Put in your 4x4 corner posts and floor joists

Now if your frame is square you can drop your 4x4x10 into the opening in the deck block and attach the frame to the post using 3 inch deck screws and 2 corner braces and (4) 20 penny spikes (see picture). I put my floor at 18 inches from ground level to allow access under the cabin if necessary and I suggest you leave some crawl space. Use your bubble level to level the post both directions but don't be to concerned if its a little out of level at the top as this will be fixed when you attach the beams and sidewalls

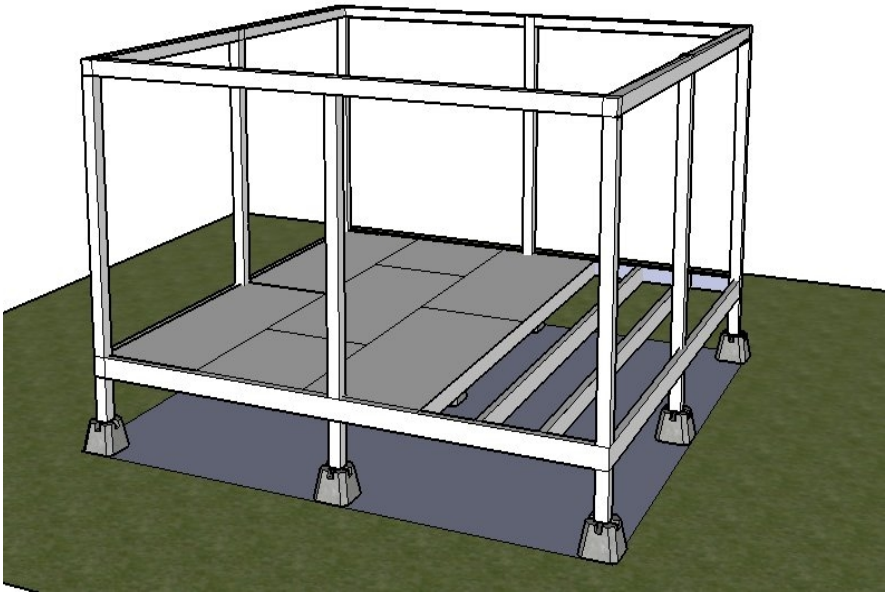
Using floor joist hangers (ask your hardware person) place your floor joist on 16" centers. You shouldn't need to cut anything if you run the floor joists the same way your frame runs. One direction of the frame will be exactly 14 feet if you put your frame together as shown.

Tip: Rough cut lumber can be purchased directly from a lumber mill or find an old house or building being demolished and salvage the lumber for your cabin. Make sure recycled lumber does not contain live insects like termites and carpenter ants. Borax soap is a natural safe pesticide when applied to wood.

STEP #3:Install your floor support girder

I used a 6" round pole for my center support girder but any good strong pole or post can be used. If necessary use a 4x4. Lay the girder under your floor joist on top of three standard cement blocks spaced evenly under the floor. You will need to shim (place small pieces of wood) under the girder until the floor joists sit solidly on the girder. Then toe nail or screw the floor joists to the girder. This girder will support all the weight in the middle of the house so do this properly or your cabin will sag and could come off the deck blocks!

Tip: Cement blocks, pavers and old brick are discarded by the truckload when old commercial buildings and houses are demolished. Ask around and you can probably get these for free for the taking.



Basic Post and Beam Construction

Step #4: Put in your floor braces and insulation

Because you will use 4x8 sub flooring I recommend a floor brace (2x4) placed 8 feet from one side of the frame. Put braces on center mark so you can attach your sub flooring directly to the brace. This way you will only have to trim one side of the sub flooring panels (see picture below for braces).

I used R19 insulation in my floor. You may not need insulation but I highly recommend it if you don't like cold floors in the morning. Notice that I placed the batts right on top of the floor joists and stapled them down. Some people say do it from the other side but because my floor will be completely enclosed there is no need and my way is much easier. I suggest laying heavy black plastic under the entire floor on the ground to act as a vapor barrier and help prevent radon gas build up.

Tip: Fiberglass Batt insulation is one type of insulation to use or you can use Styrofoam, or cellulose (shredded paper).

Step #5: Put on your sub flooring

I used 3/4 inch tongue and groove wafer board sub flooring. Its heavy and solid and won't sag under heavy feet. use a block and a hammer to tap stubborn sheets in place until the grooves match neatly. Use 1 1/2 inch deck screws every 12 inches to secure the flooring. You will need to trim out a 4 inch opening in each corner to fit around the posts. Save the trimmed pieces and fit them back around the post for a finished look. Trim off the flooring to fit smoothly on the frame. Save these scrap pieces as they make great shelves for inside the cabin!

Tip: A sub floor can be made of any good solid wood of equal thickness. You will probably paint or cover this floor with rugs or other material so use your imagination. Check with the local flooring installers and see if there is a home around that is having old hardwood flooring replaced and offer to help remove it for salvage.

Step #6: Install beams, sill plate, and wall studs

I used (4) 2x4s screwed together to make each of the cross beams. Measure the distance between the corner posts at the base and cut your beams to that length for a tight fit. Attach beams to corner posts at 8 feet from floor using metal L braces (see hardware person). Level the corner posts with your bubble level and you may need to push or pull them to get them level. Sill plates are 2x4s screwed to sub flooring and floor frame. Wall studs go on 16 inch centers between beams and sill plate. Toe nail or screw in place. Decide where your door and windows will be before putting in your wall studs!

Tip: Most glass and door installers give away or sell salvaged windows and doors. My recycled doors are steel insulated and were free from a glass shop. Try to get insulated solid core doors. Windows should be double pane with wood or vinyl frames if possible. Avoid single pane windows and cheap metal framed windows that leak.

Step #7: frame your doors and windows

When deciding where doors and windows go here's a little advice. Put most windows on south side to catch the sun in winter (I have 3) and few if any on the north side (I have 1) to avoid heat loss in winter. Because all windows and doors are different you should measure yours and make openings to fit. Most exterior doors are 36" x 6'6" but you may build your own any size. Frame the openings with 2x4s screwed to your wall studs.

Step # 8: Put on wall sheeting

I used exterior grade T111 plywood for my wall sheeting but clapboard or other material should work just fine. The walls are 8 feet high so just lean the panels up and screw them to the studs. I cut my door and window openings out after I attach the sheets using a power jig saw. (see picture above). Now is a good time to install your doors and windows if you have them. A little advice- hinge your doors to swing outwards to save room in the interior of the cabin.

NOTE: You may choose to install a vapor barrier such as tyvec or roofing felt under your wall sheeting. This is recommended in high wind, rain, and humidity locations but is not necessary in all locations and is not included in the material costs in these plans.

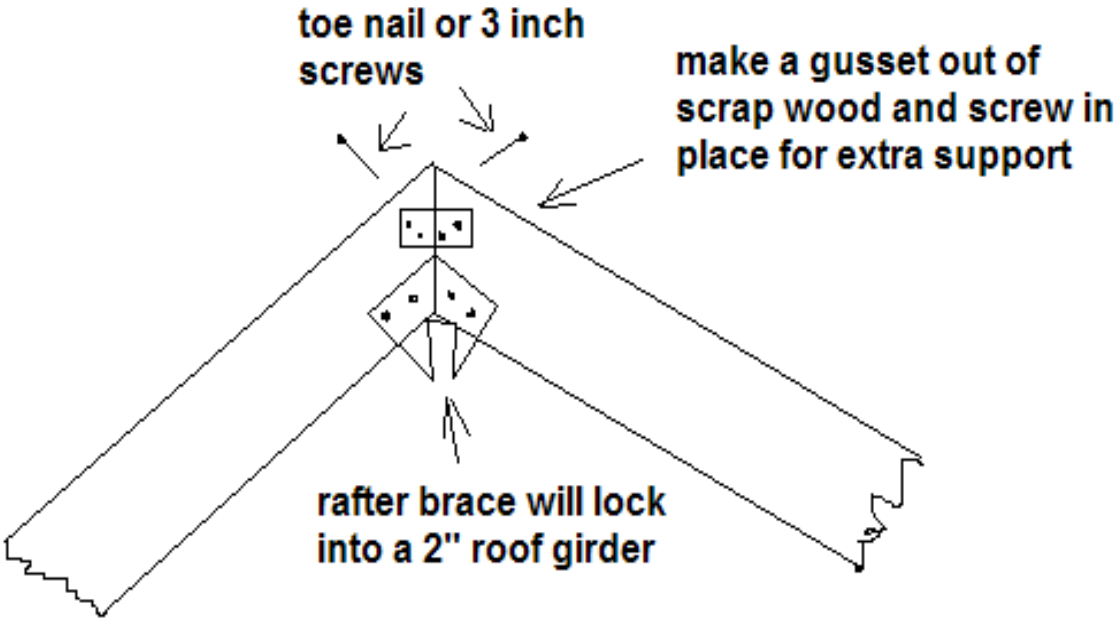
Step #9: Build your loft

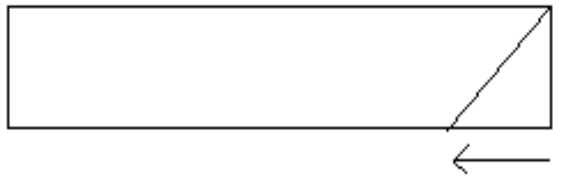
I assume you will want the loft as it doubles your interior space but you could leave it out or do a half loft as you want. I used 2 x 6 x 14s for the loft joists attached directly to the wall studs at 7 feet from floor with a second 2x4 brace placed under each joist for additional support. I used 5/8 wafer board for the flooring screwed every 12 inches for strength. Putting your loft floor at 7 feet high will give you 7 feet head room downstairs and 7 feet of head room at the peak in your loft. Decide where your loft access door will be. I suggest putting it in the center near an end wall so you don't bump your head climbing into the loft. A good size access door is at least 36" x 36" so you can get furniture upstairs. You can build a simple ladder out of two 2x4s and several 2x4 braces spaced about 2 feet apart and attached to the rails using 3 inch screws.

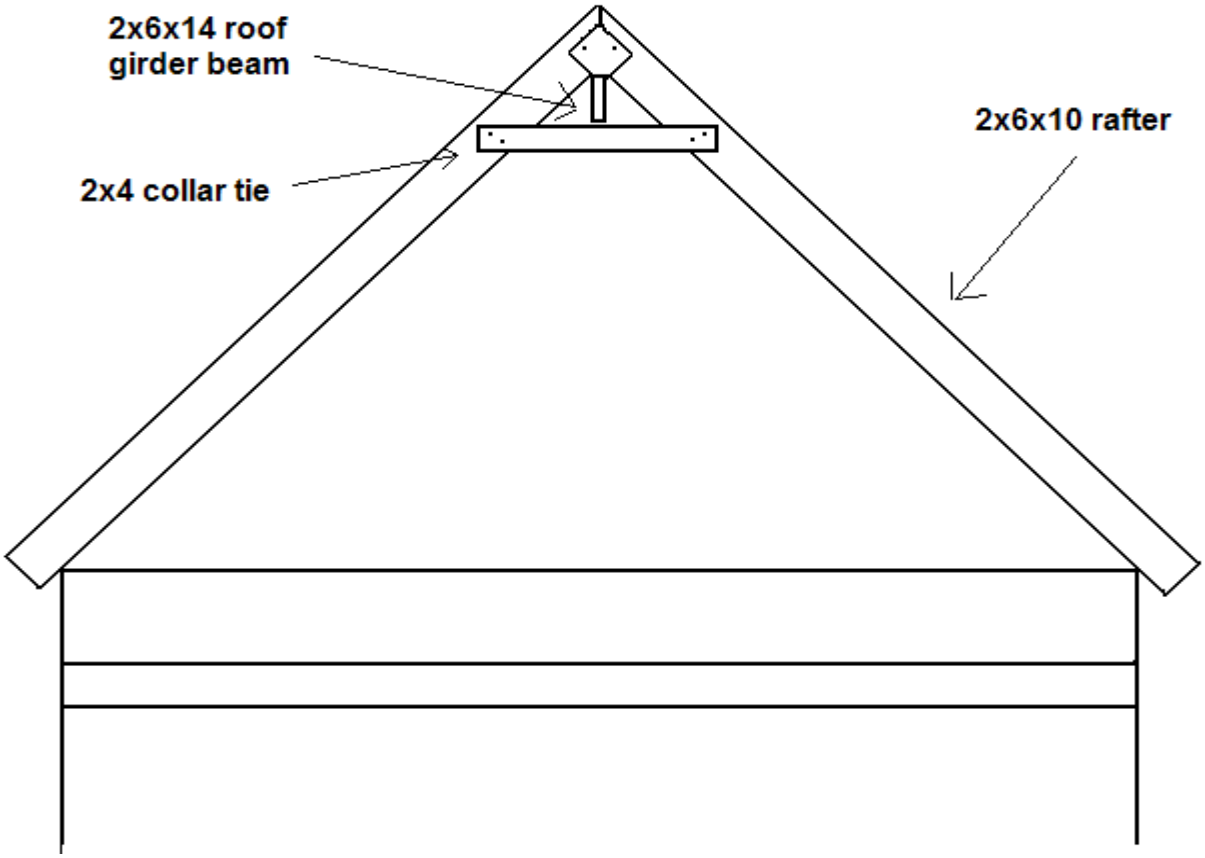
Tip: Attic space is usually wasted space but a loft will almost double your living area and is a great place to put a bedroom which is used primarily only at night for sleeping. Lofts usually stay warmer on winter nights as warm air rises.

Step #10: Build your roof rafters

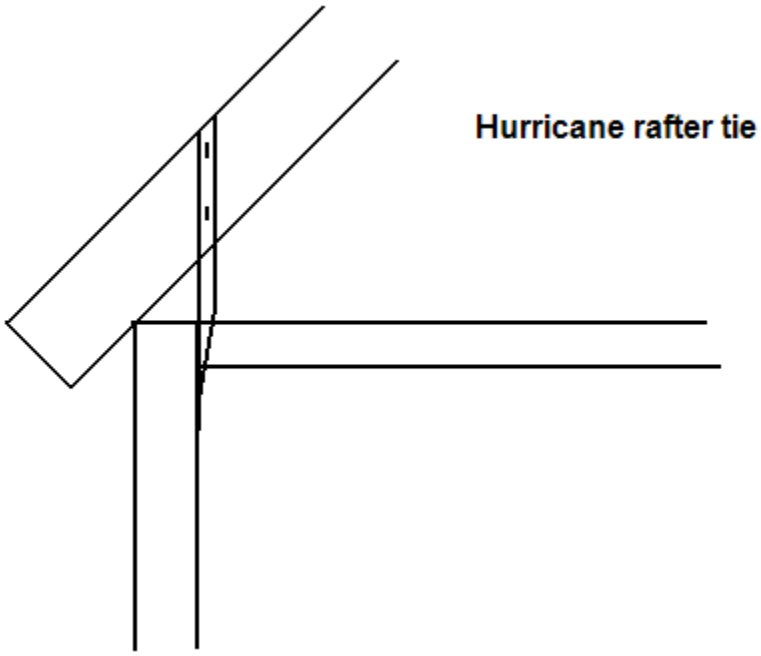
I used 2 x 6 x 10s for my rafters because that gives me a 5" overhang and 7 foot headroom at the peak. To make your rafters cut 4 1/2 inches angled to the corner of the rafter which is slightly more than a 45 degree angle. Toe nail or screw two rafter sides together to form a big V. Attach your rafter brace using screws (see hardware person). Rafter brace should accept a 2 x 6 or 2 x 8 inch girder. I also made a small gusset of scrap wood that I screw to each rafter for extra support while I put them in place.


toe nail or 3 inch screws
make a gusset out of scrap wood and screw in place for extra support
rafter brace will lock into a 2" roof girder





Here you can see how rafters sit on the roof girder and collar ties hold it all together



Here you see how the roof rafter is attached to the wall using a metal rafter tie

Here you can see the first rafter in place and window already framed and installed. Attach your end rafters directly to the 4x4 corner posts. Cut off the excess corner post that extends past the rafter with your skill or hand saw. Put a scrap 2x4 brace on this first rafter and attach it solidly to the loft floor or you may hear a big crash!

Step #11: Put in roof girder and install rafters

Use a 2x6x14 for your center roof girder. Screw it in to the first rafter brace and place a 2x4 scrap brace under the other end so it is level (use your bubble level to level the rafters and the girder). This step is easier with two people but I did it myself. Attach a collar brace to at least a couple of your rafters I put one on every 3rd rafter). A collar brace is just a 2x4 that lays under the girder and is screwed or nailed to both sides of the rafter for extra support.

Slide your rafters over the girder and lock them in place with screws through the girder brace. Rafters go on 16 inch centers. Attach the bottom ends of rafter to beams using metal rafter braces (see hardware person).

Tip: Installing rafters is really a two person job. I did this myself but it was not the smartest or safest way to do it. I highly recommend getting some help for this step of the construction.

Here's the roof with all rafters in place and windows framed and installed. Now its looking like a cabin!

Tip: If you build your loft first you can stand on this floor to install your rafters much easier and safer. If you are working from a ladder be VERY careful as rafters are heavy and unwieldy. Get some help with this step please!

Step #12: put on your roof sheeting

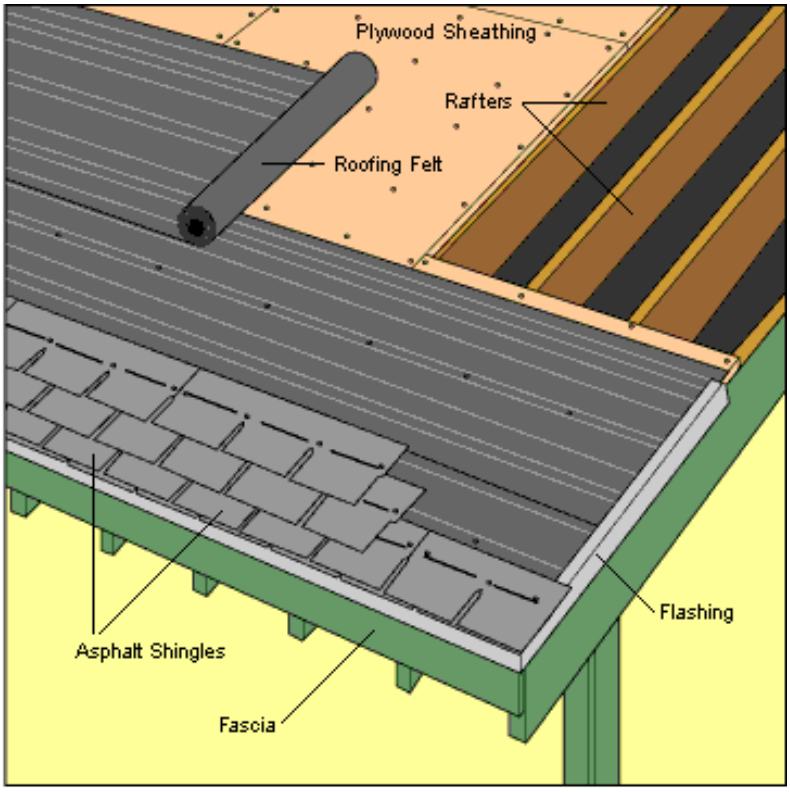
I used 5/8 wafer board but you could use 1/2 inch or another material such as pine boards. It is easier to slide panels on to roof from the ground and tack them in place and then go back up to loft to put screws in at 12 inch spacing.

Here's the cabin with roof sheeting installed. Notice the over hang. If you use 4x8 sheets you won't have to cut much and it will give you a 1 foot overhang on each end to shade the upstairs windows in the summer. I used 30 pound Tamco roofing felt and felt nails under my shingles. You can also use this under metal roofing if you decide to go that way. Put on a metal drip edge over the felt and under the shingles to prevent rain and ice from dripping under your eves. You can attach a 2x4 to the front and rear overhang edge for a nice finished look and I cut a sheet metal triangle to cover the small gap at the peak and give it a unique finish.

Tip: I used asphalt shingles which are fairly cheap and widely available but if you want to catch rain water I would suggest a metal roof instead. The cheapest is the shiny corrugated metal roofs used on barns and sheds and it reflects sunlight to reduce heat in summer.

Step #13: Install your shingles

I used Tamco 30 year shingles because I was doing the job myself and they are easier to handle, but a metal roof would be great, If you have never installed shingles read the back of the package and follow the directions and you will do fine. Use some of your scrap lumber to enclose the rafter ends. I used the pieces of T1-11 left over from cutting out the doors. Just screw them to the rafter ends and bottom to enclose the roof.



Step #14: Insulate walls and roof

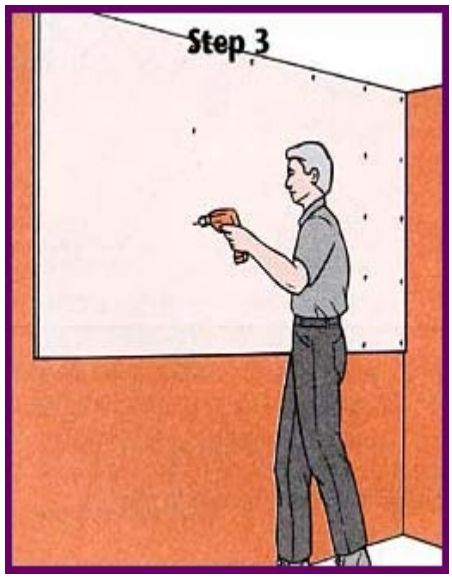
I used R19 batt insulation but blow in would work. Go with the highest R value in your roof as that is where you will lose most heat in winter and gain it in the summer. If you have never installed insulation read the package and ALWAYS wear gloves, mask and eye protection.

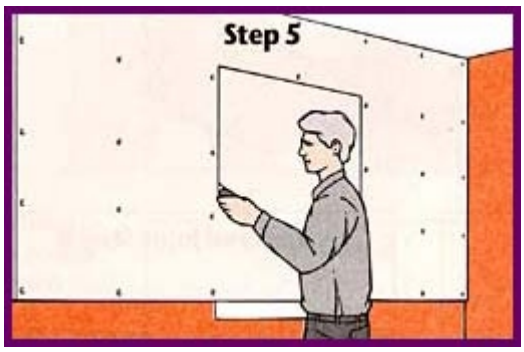
Place insulation batts between studs

Staple batts to studs

Step #15: Put up interior wall material

I chose 5/8 inch drywall because its cheap and easy to work with but you could do paneling, bead board or something else. I would recommend using a material that has some fire resistance especially if you plan on having a wood stove! Just measure your walls and score the drywall with a razor knife. Give it a smack with your hand on the scored line and the drywall will break cleanly. You can clean up rough edges with a drywall rasp (ask hardware person). I don't even use seam tape on my drywall. Just cover screw holes and seams with a little drywall plaster, paint it and cover corners and seams with some kind of molding. I use cedar fence boards cut in half for nice looking trim work throughout the cabin.





Pictures courtesy of http://www.mygreathome.com/fix-it_guide/drywall.htm

Tip: The interior of your cabin is an area where you can really save and be creative using recycled materials. I used recycled cedar fence boards for trim work. I have hardwood flooring that was purchased cheap because it was discontinued. Because the cabin is small I didn't need much paint so I scrounged together what was left over from other projects. Many building supply stores, floor covering stores, and retailers have discontinued or sample sales for products that they don't have enough of for a big home that will be perfect for your cabin.

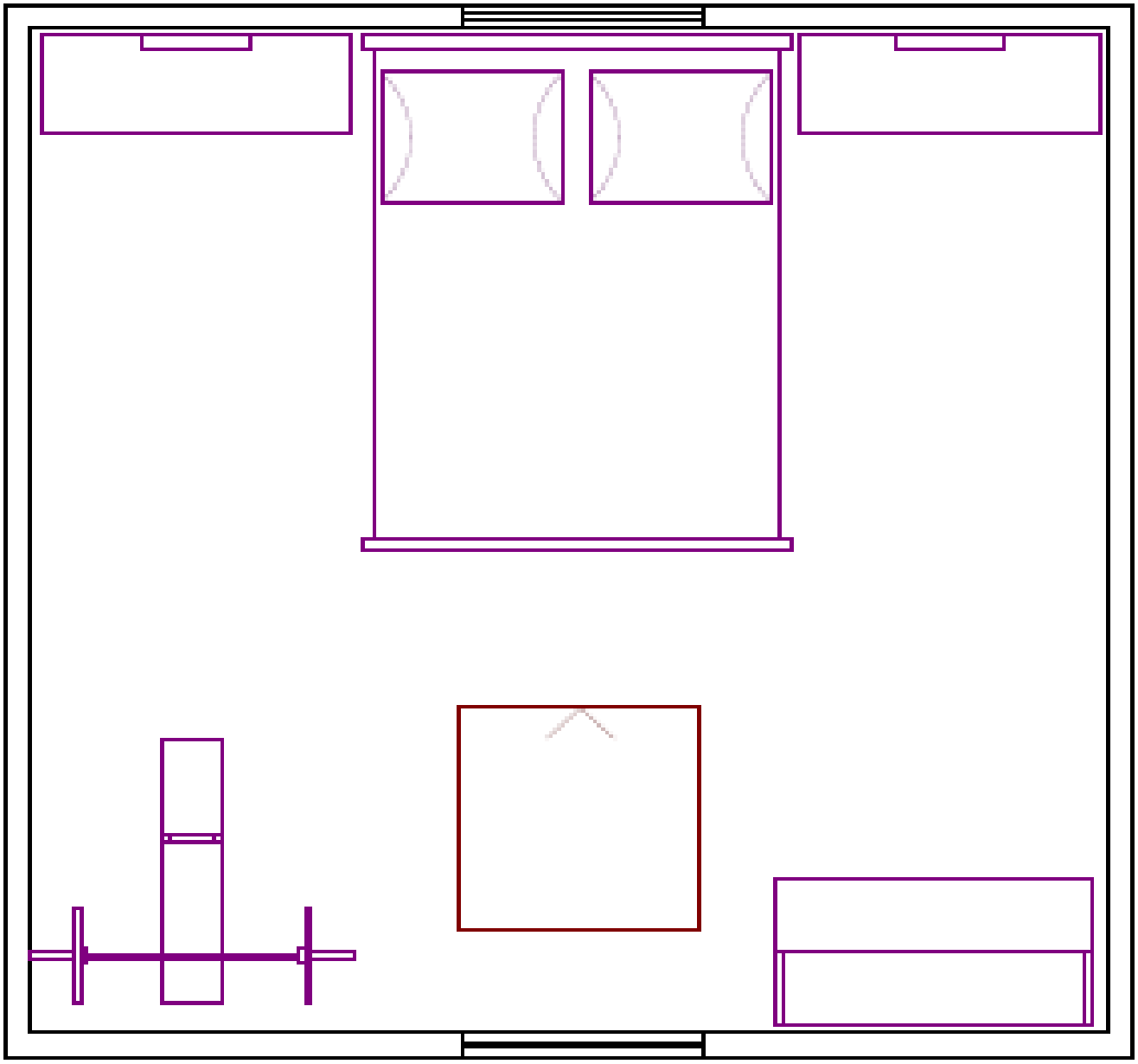
Furniture stores sell scratch and dent stuff at reasonable prices or you can hit the yard sales and do some bartering. I traded cabin plans for a kitchen table, paid $5 a piece for oak kitchen chairs, and was given a shower base that was too small for my brothers house.

In my opinion a cabin or cottage looks best with antiques and craft items instead of plastic store bought cheap stuff. If your handy with tools then consider making log or twig furniture for your cabin, decorate with natural items like tree branches, shells, antlers, and rocks. Let you imagination run wild and create something unique!

Picture courtesy of http://www.reddeerriverranches.com

Here you can see how I designed my main floor. There is a full corner shower, sink, stackable washer and dryer and a composting toilet in the bathroom. A propane fridge and stove and a sink in the kitchen. There is a 4 person dining area and a full size futon couch and entertainment center in the living area. The main floor is approximately 14x14 with 7 feet of headroom to the loft above.

Tip: If you already have furniture for your cabin measure it and see where it can best fit for your floor plan. I had a lot of "stuff" I had collected over the years and I had to decide what I really needed and what was necessary in the cabin and give away the stuff that wasn't. I went from two large TV's to one small flat screen tv. I went from a big desktop computer to a small laptop. My couch is a futon so guests have a place to sleep. I designed storage under my sink for a water tank. I chose an on demand water heater and stackable washer dryer to conserve space in the bathroom. Try to design your floor plan so you have areas for eating, sleeping, bathing but remember your space is limited and you will use most those areas for only a few minutes each day.



Here’s my loft design. I have a queen size bed and two large dressers with mirrors on one wall. My desk and exercise equipment on the other wall. The box in the middle is the loft access door which is 36"x36" and a ladder slides under the bed when not in use. The loft is approximately 14x14 and has 7 feet of headroom to the peak.

Well that’s it for the cabin plans folks, I have included other pictures of my own finish work so you can get ideas but don't be afraid to let your own style come through in you cabin. After all we are individualists that don't all want to live in the same style cabin right!

Picture from inside the loft

Here you can see how I finished the foundation. I used 5/8 wafer board painted grey to look like cement. Eventually I will rock the foundation with river stones. My trim work is all rough cut pine 1x6s I get directly from a small lumber mill up the road.

Here's my solarium porch. It is 7x14 and I used 2x6s for the floor, pine poles for the corners and, rough cut 1x6s for the decking. I used the same 30 pound felt and tamco shingles as on the cabin for the roof. The poles sit on 1x1 cement blocks to prevent rotting and termites.

Rough sawn lumber has that cabin look and is cheaper!

Cabin right after construction. Notice the ladder to loft.

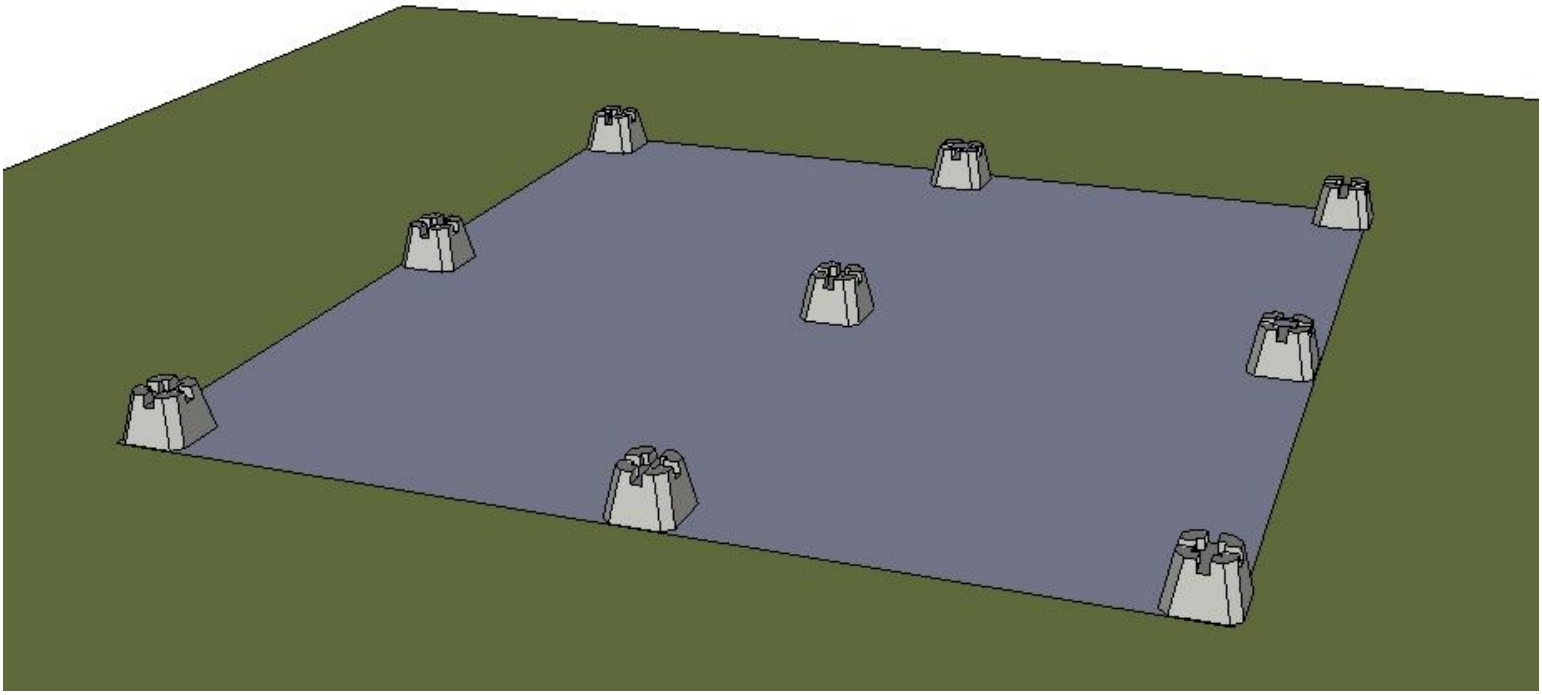
Finished cabin as it looks today. Solar powered and passively cooled.

Material list for cabin

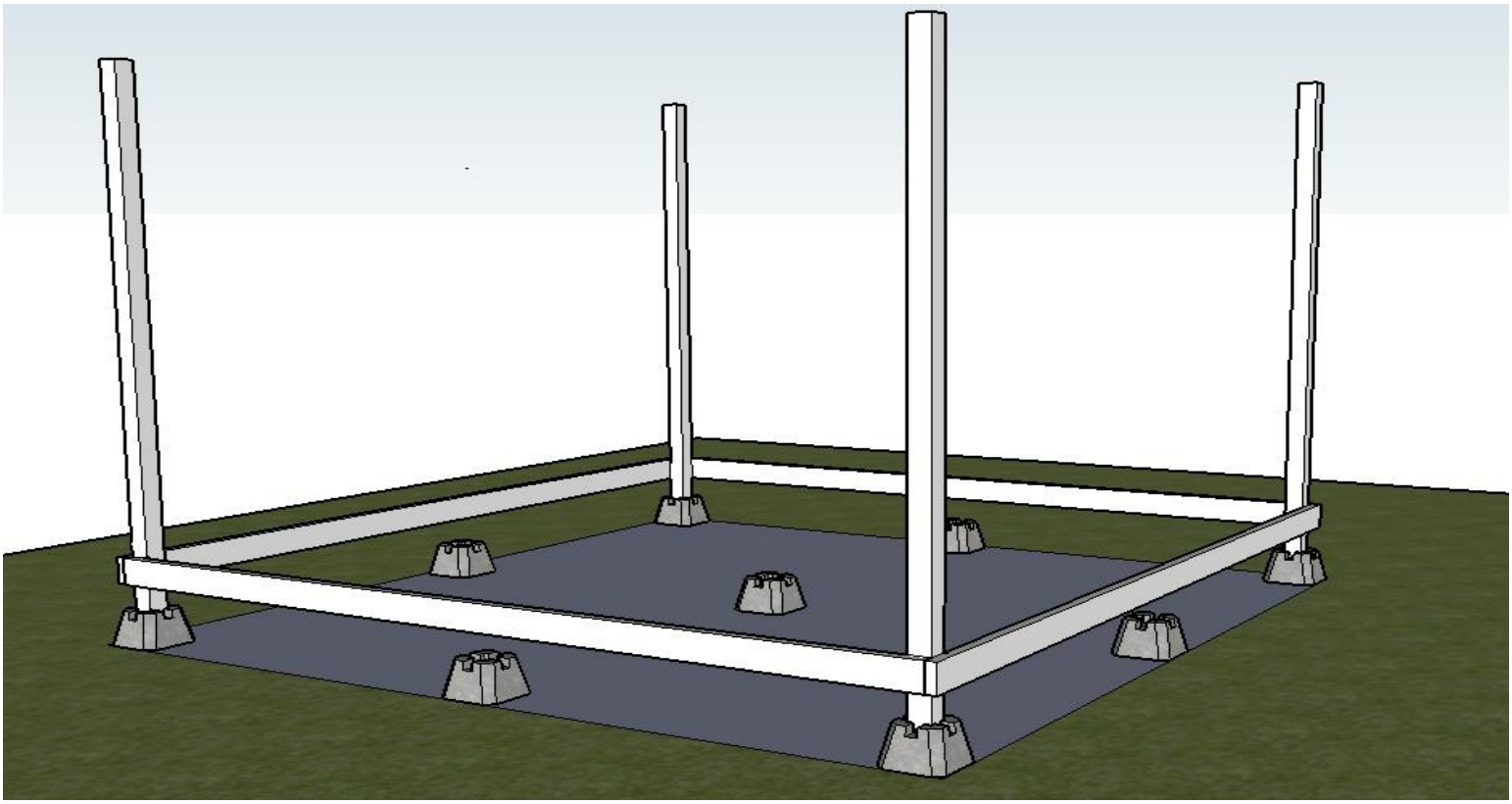
Foundation:	
6 deck blocks @ 4.50 =	**$27**
3 concrete blocks @ $3 =	**$9**
1 center pole girder	**$7**
total =	**$43**
Floor:	
14 2x6x14s @ $7.50 =	**$105**
6 4x8 t+g sheets @ $15 =	**$90**
3 rolls R19 insulation @ $24.00 =	**$72 (optional)**
total =	**$267**
Walls:	
4 4x4 corner posts @ $10 =	**$40**
65 2x4x8s @ $3.50 =	**$230**
8 rolls R19 insulation @ $24 =	**$192**
14 4x8 T111 siding @ $15 =	**$210**
14 4x8 drywall @ $12 =	**$168**
total =	**$840**
Loft/ceiling:	
10 2x6x14s @ $7.50 =	**$75**
6 4x8 5/8 wafer board @ $12 =	**$72**
total =	**$147**
Roof:	
24 2x6x10 rafters @ $5 =	**$120**
10 4x8 5/8 wafer board @ $12 =	**$120**
2 rolls roofing felt @ $15 =	**$30**
6 squares tamko shingles @ $49 =	**$294**
4 rolls R19 insulation @ $24 =	**$96**
total =	**$656**
Misc:	
screws and assorted metal hangers	**$40**
Grand total =	**$1997.00**

*** does not include tax, windows or doors. Some figures are rounded up for simplification. Costs are approximate based on local dealer discounts.**

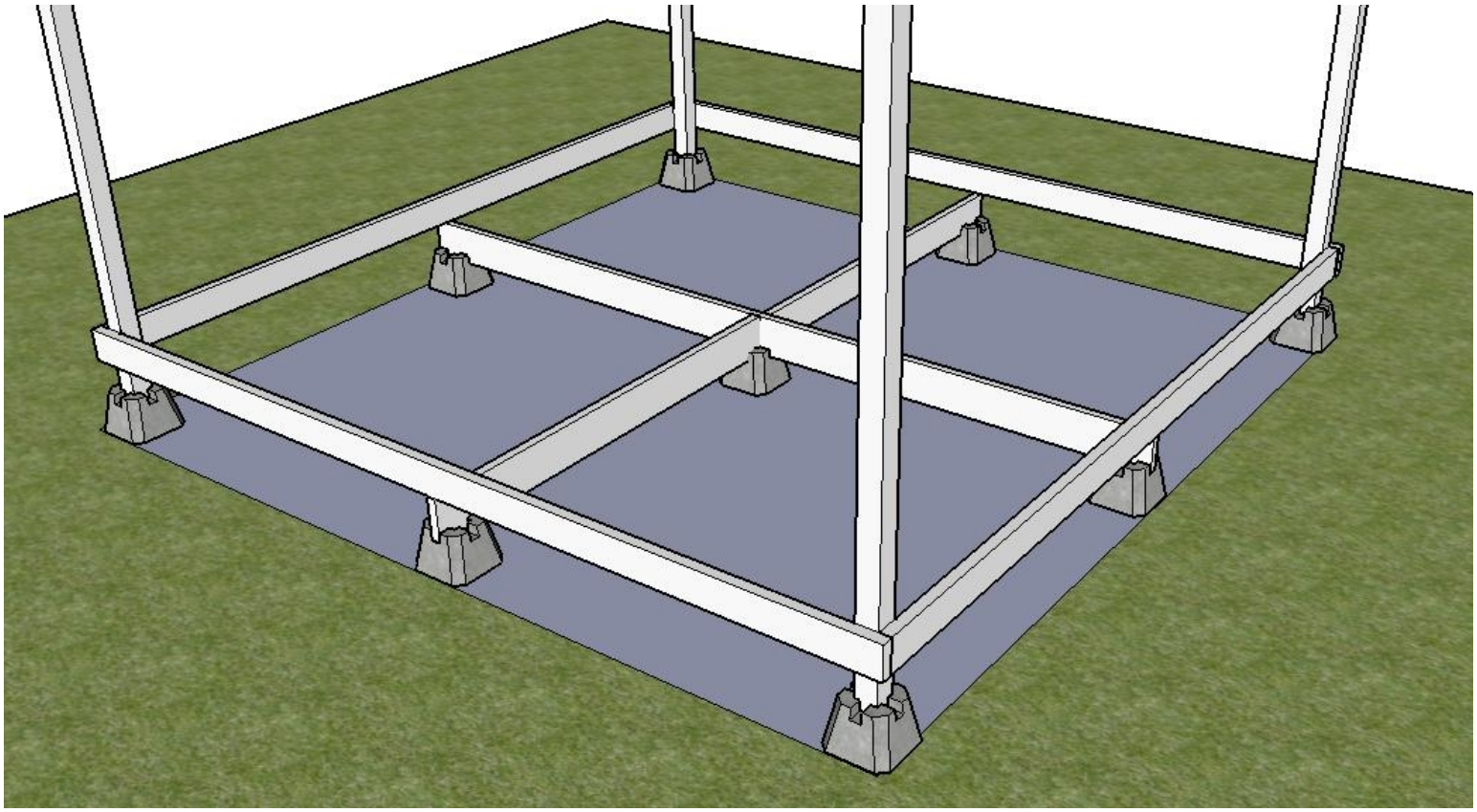
Visual Construction Steps



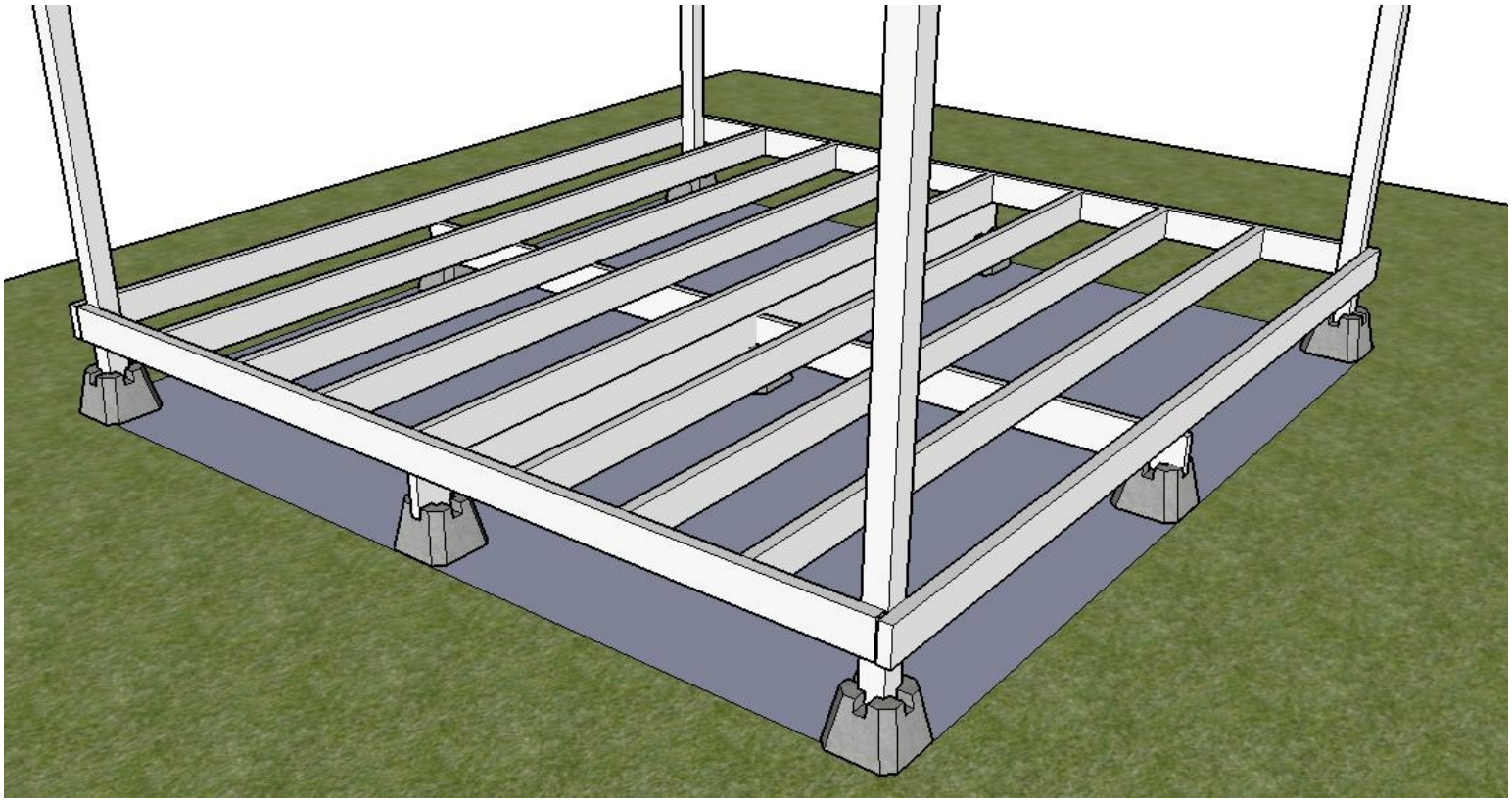
After clearing and leveling ground lay out your ground cover plastic and cement deck blocks in a 14x14 pattern



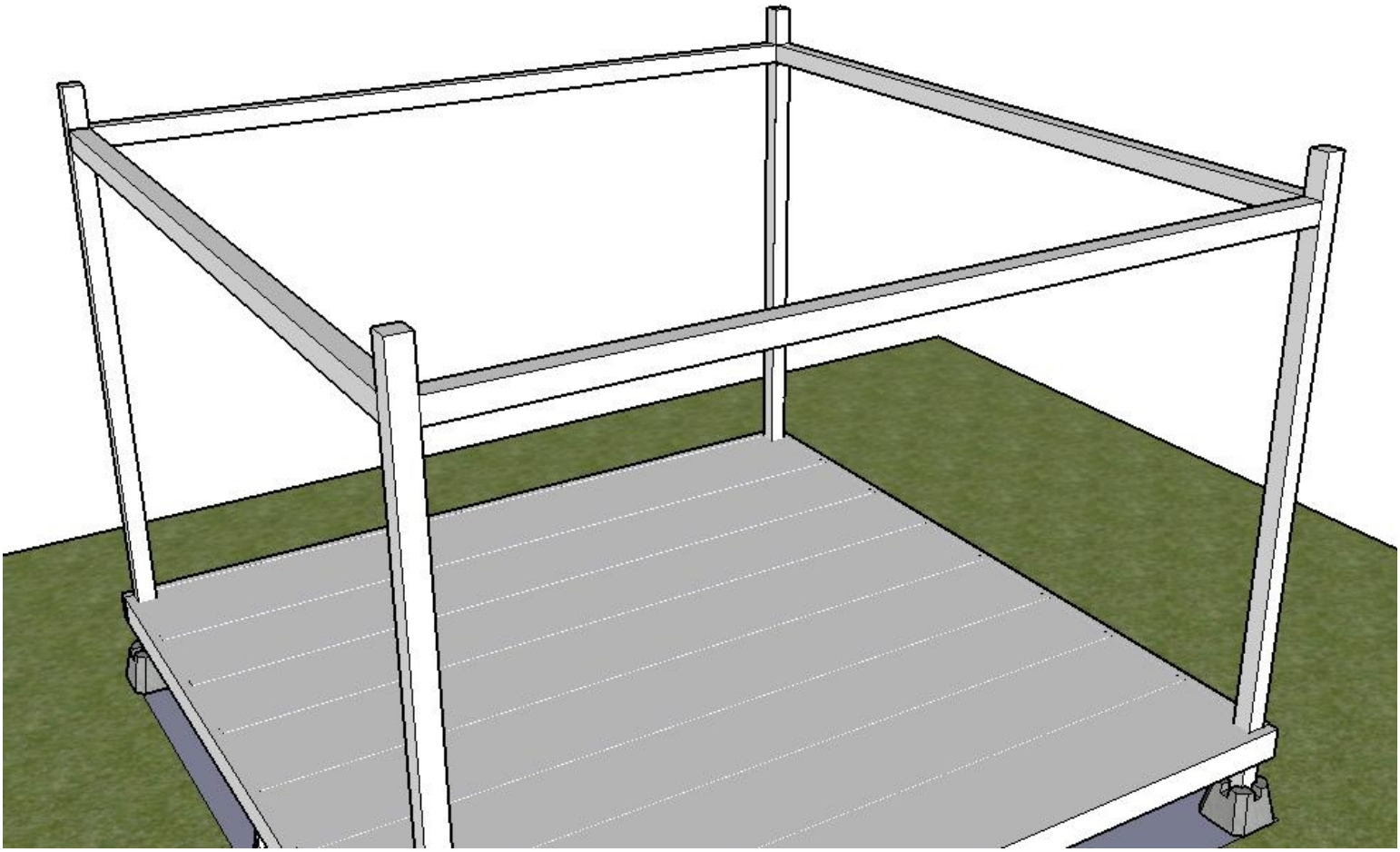
4x4x10 corner posts are set in deck block and secured with 2x6x14 ridge beams. Attach corners with three 6 penny spikes



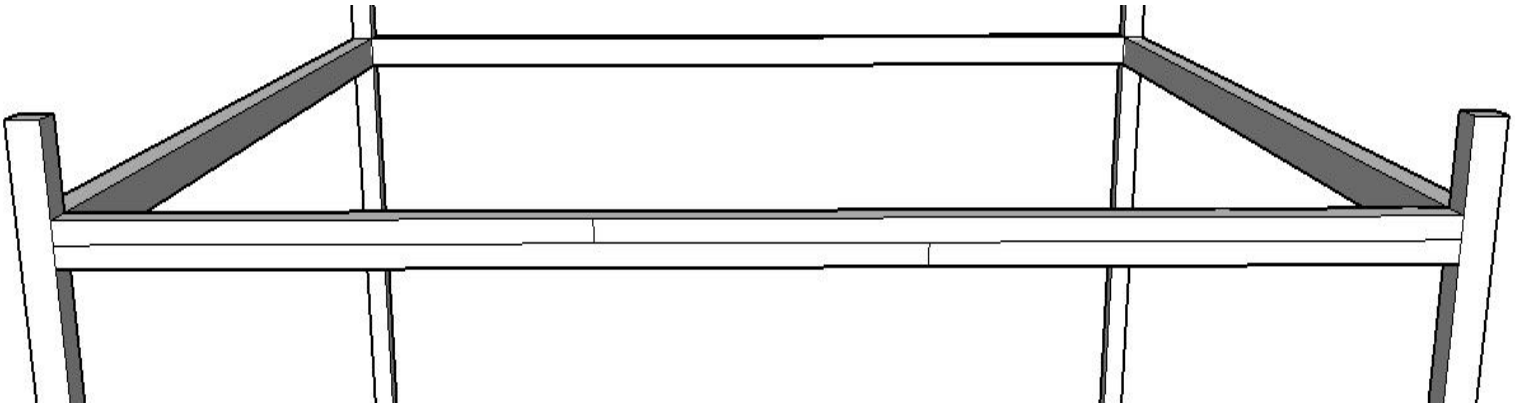
Brace floor using 2x6x14 and shim. Square and level all corners.



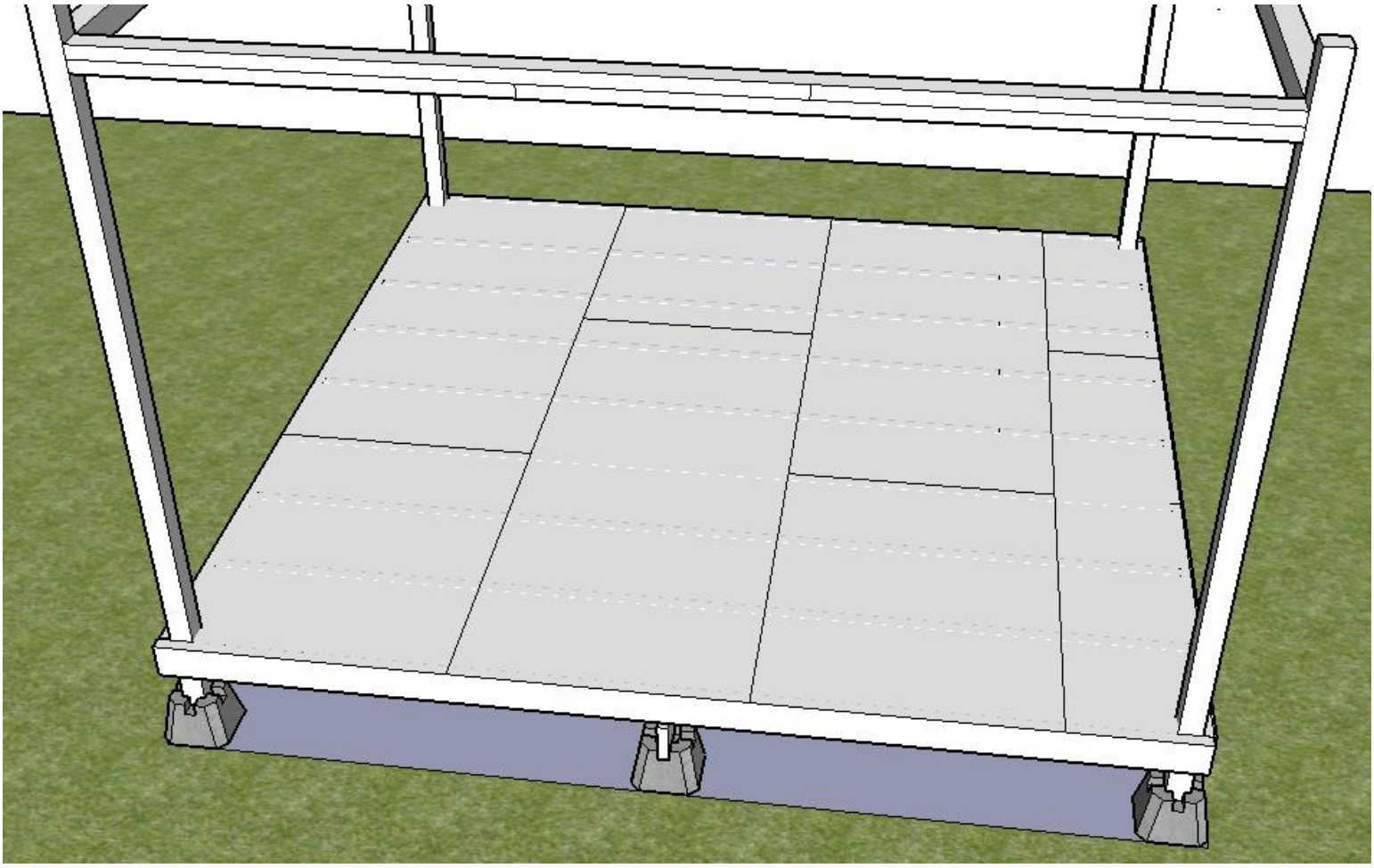
6x2x14 Floor joists are installed on 16 inch centers



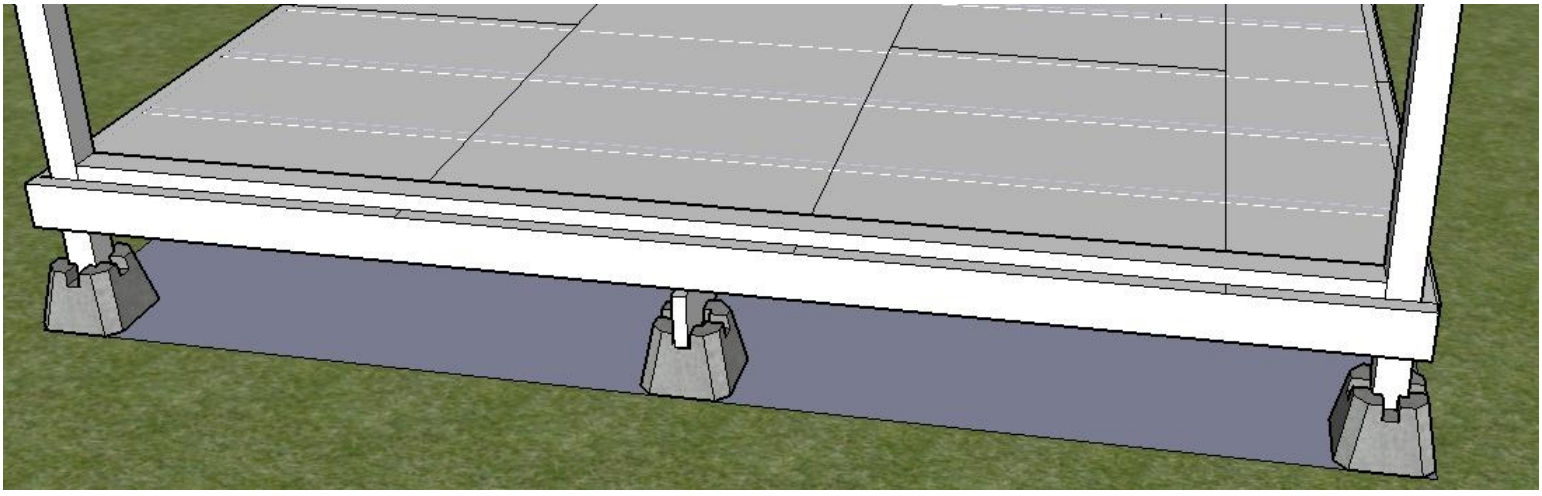
2x4x8s are used for a header and over lap the seams. Attach ends will L braces



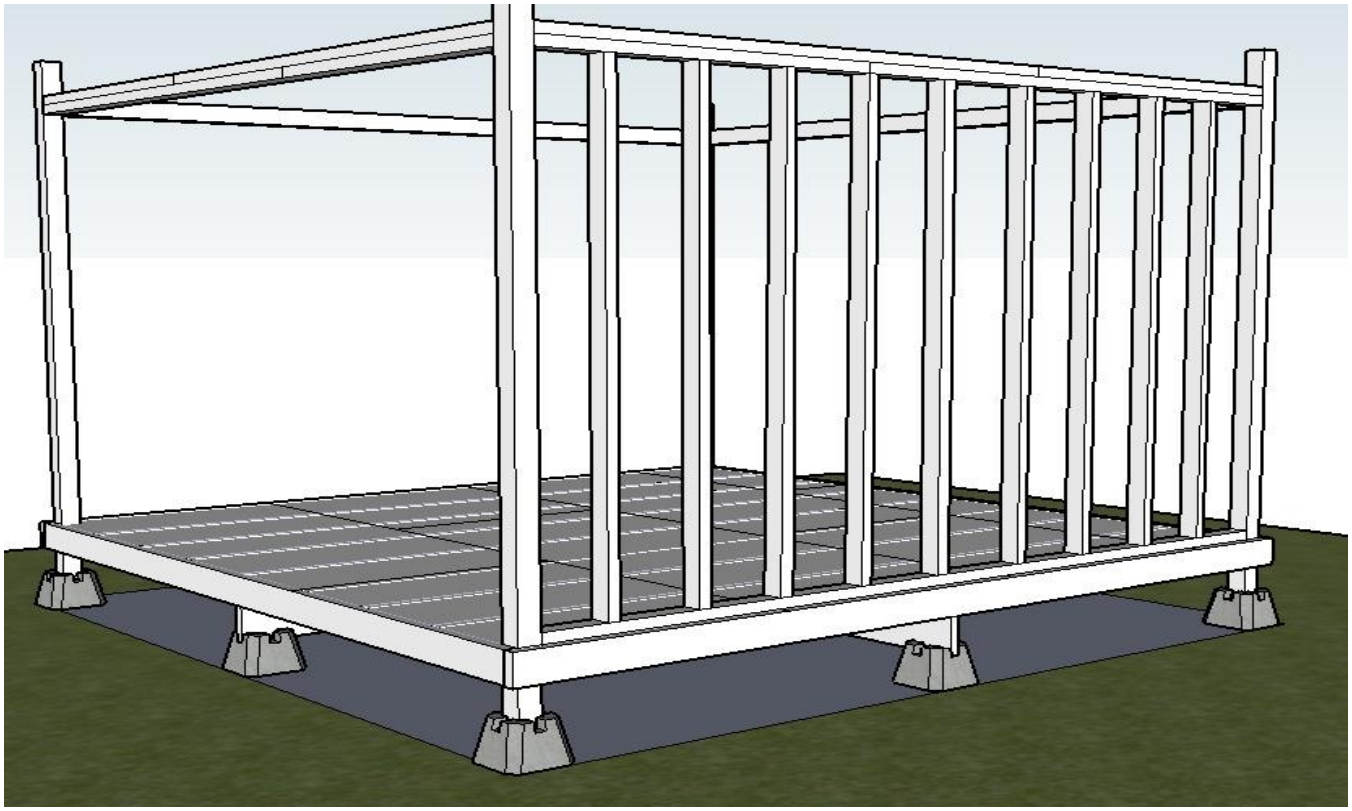
Second view of header showing overlapped 2x4x8s



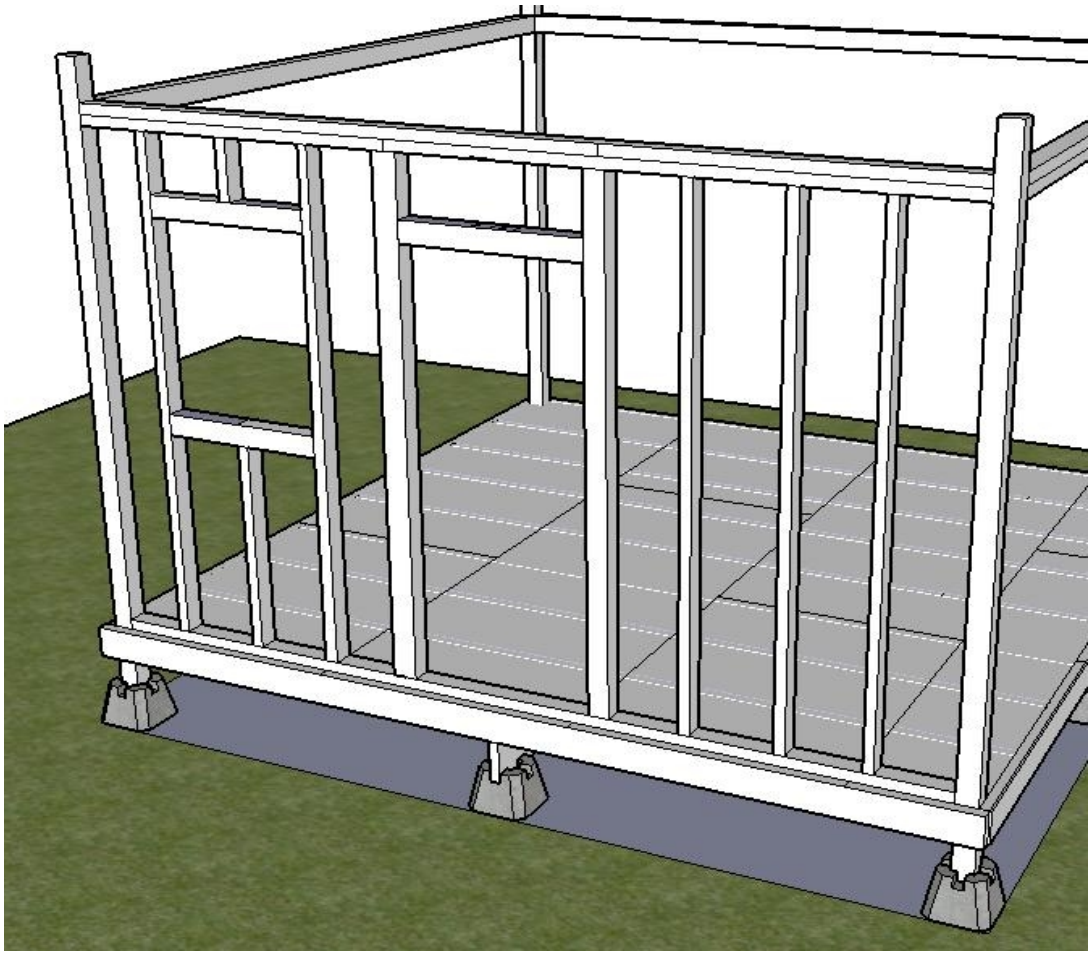
Lay 4x8 wafer board T&G flooring with alternating seams



Footer is 2x4x8s spliced and attached to floor girders through flooring



Solid wall with no windows are 2x4x8 studs on 16 inch centers



Frame in door header and window openings with double 2x4 bracing

Siding attached to wall studs and doors and windows installed as desired

Simple ways to reduce building costs:

Use recycled materials. Good used doors and windows can be had for free or cheap at most window shops for the asking or removed from homes being remodeled. Use double or triple pane low E glass windows with vinyl or wood frames and insulated doors if possible.

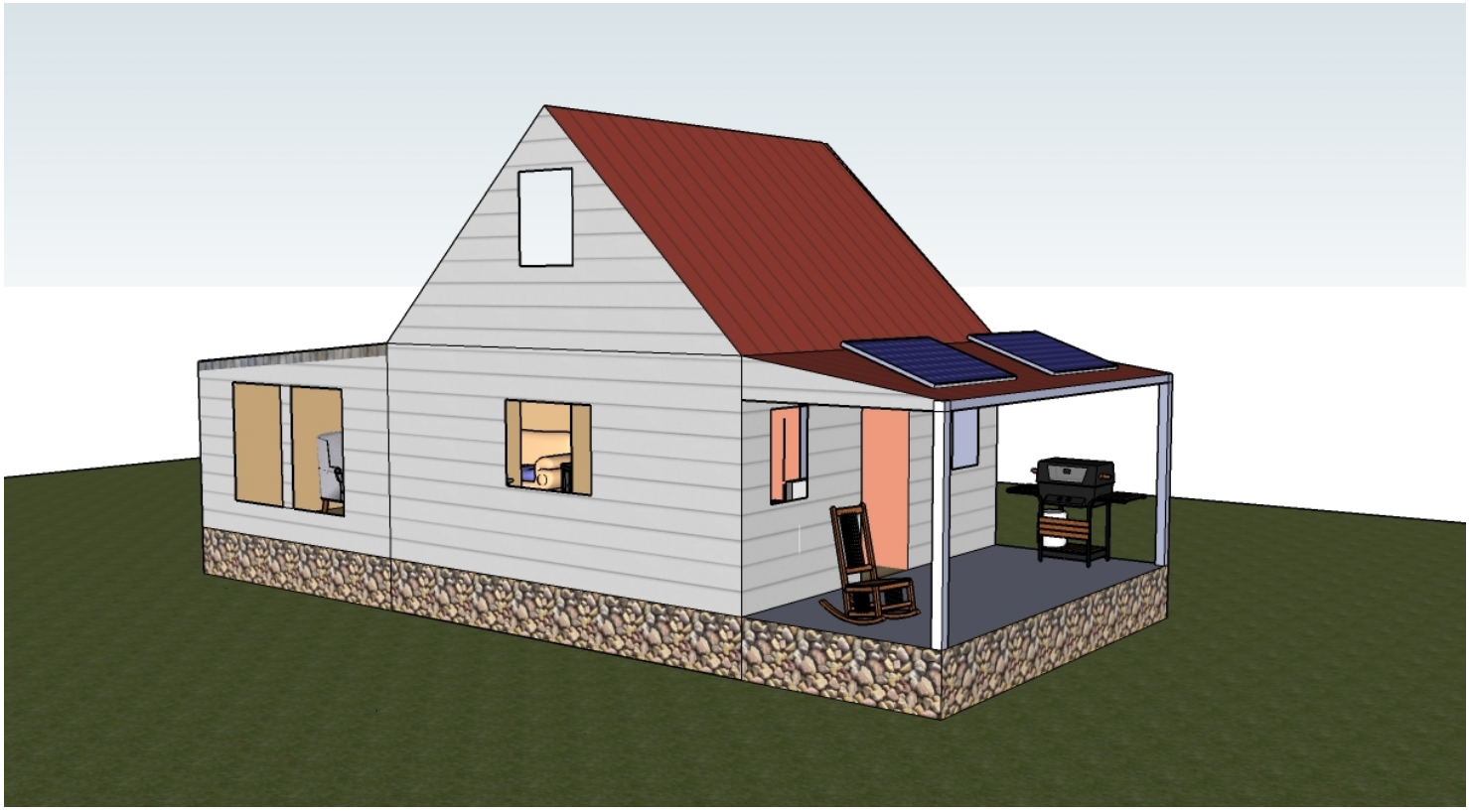
Use recycled wood and rough sawn wood. Homes being remodeled or torn down have many good building materials. Lumber mills keep stacks of rough cut lumber available at much lower prices than store bought conventional lumber.

Visit recycle and home salvage shops and haggle over prices. You can get flooring, windows, doors, tubs, showers, appliance, wood stoves, and tons of stuff at these stores.

If you have to buy new lumber take in your complete material list to the contractor desk and ask for a bulk purchase discount and they may even throw in free delivery!

Doors, windows, flooring, paint, hardware, and lots of stuff!

Building Cabin Additions



The cabin is designed to have the porch placed on any side and additions on 3 sides

Here is the cabin with porch, addition and a nice carport

Here are plans If you want to build on a simple addition for the solar cabin. The original cabin is almost 400 square feet which is adequate for a small family of 3 or 4, but as kids grow or you decide you want a little more room .

The addition is 14x14 with a shed lean-to style roof and is designed to be either attached directly to the existing cabin or freestanding next to the cabin. The principle design is very much the same as that you used for building the original cabin. You can easily adapt these plans fro a 12x14 addition or any other size desired.

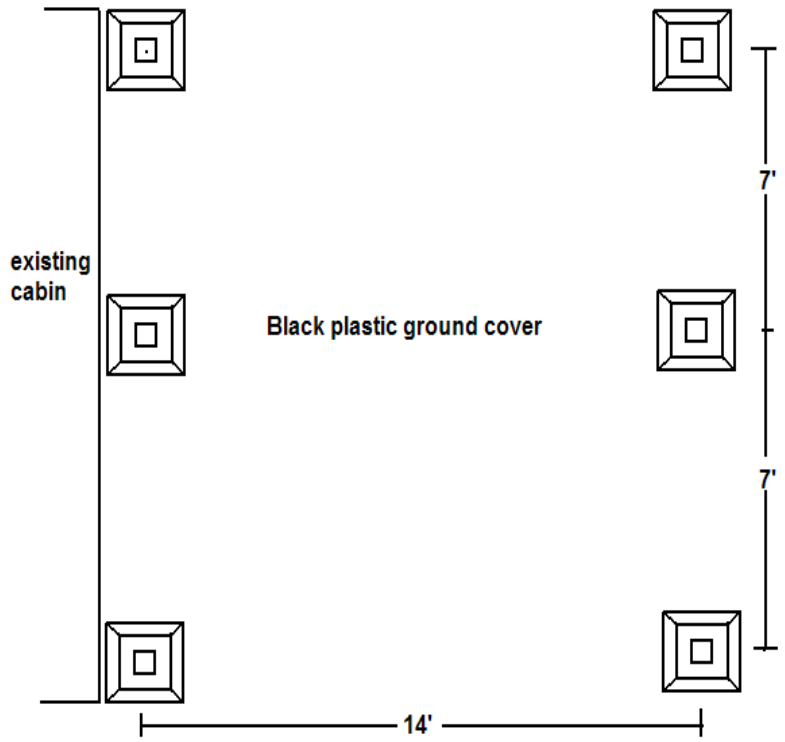
Step #1: Decide on which side of the cabin you want to build the addition. I have drawn the addition from a right side addition perspective but you can use the plans in mirror image for the left side if desired, or you addition could be built on to the back side of the cabin. I would put mine off the back of my cabin where I already have an access door.

Step #2: Clear away any weeds and remove anything that might interfere with the addition placement. Lay a piece of black plastic down on the ground to stop weed growth and place 6 deck blocks on the plastic as shown below.

NOTE: If you want a permanent foundation then use pier tubes and concrete poured below the frost line and a 4x4 deck post pier. For these plans we will use the deck blocks.

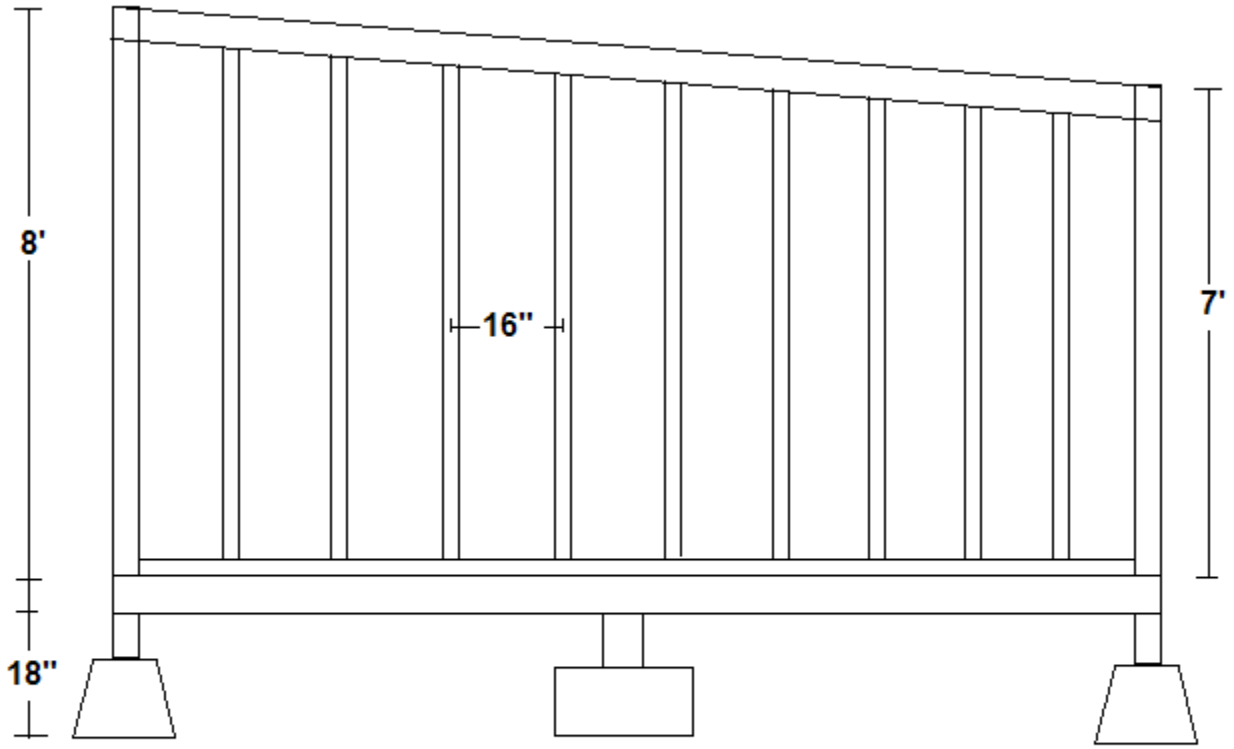
Step #3:

For your foundation you will need 6 deck blocks that accept a 4 x 4 post available from your lumber store or any place that sells lumber for decks



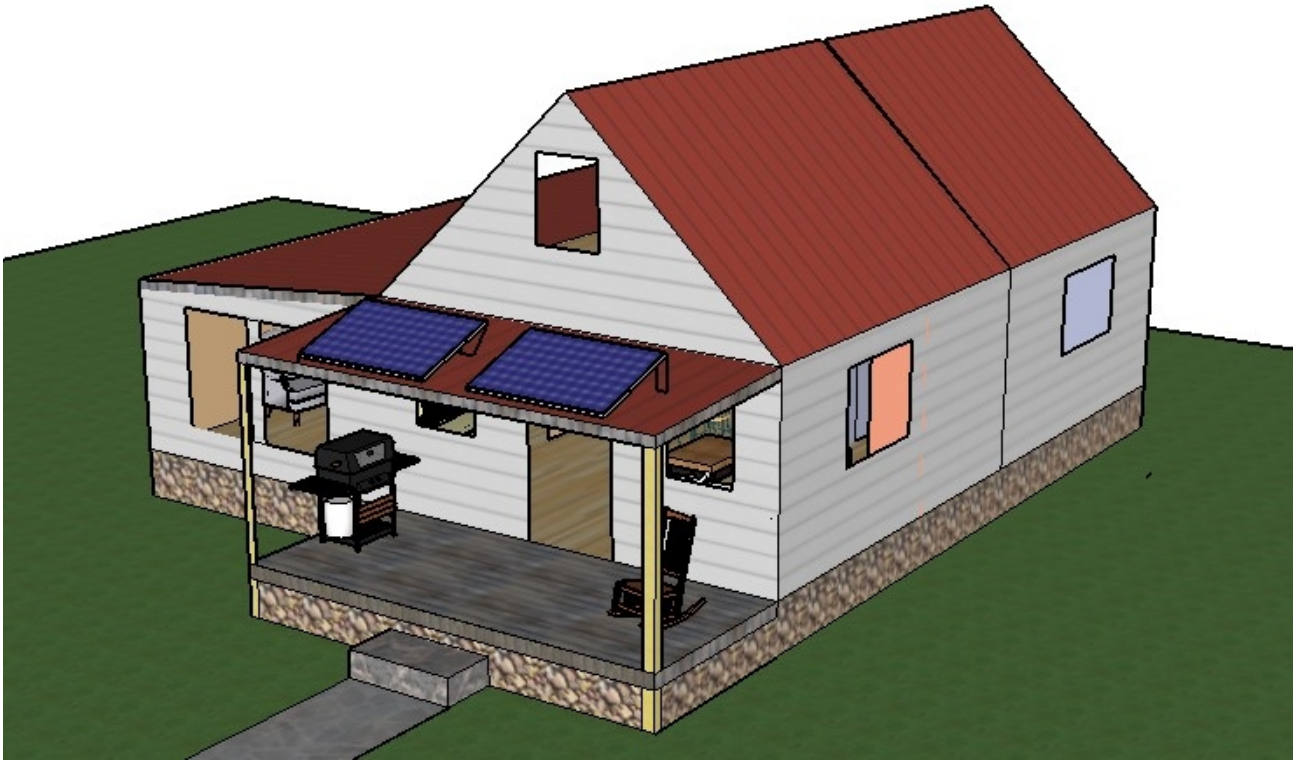
Place the deck blocks on firm ground. If necessary, tamp the earth down solid with a big heavy log. You will need (5) 2 x 6 x 14 pine boards and (4) 2 x 6 corner braces for the frame. Screw the frame together with the mounting braces and place the frame on the deck blocks as you did for the cabin.

Now square your frame by taking a piece of string and a tack and place the string from one corner to the other cross corner. Mark where the string comes to the corner. Then do the same thing on the opposite corners. You will have to move corners in or out until you get a perfectly squared frame also adjust the deck block so they are directly under the frame corners ready for the 4x4s. If you skip squaring the frame your wall and roof panels will not fit without lots of trimming and waste so take the time to do this step correctly.

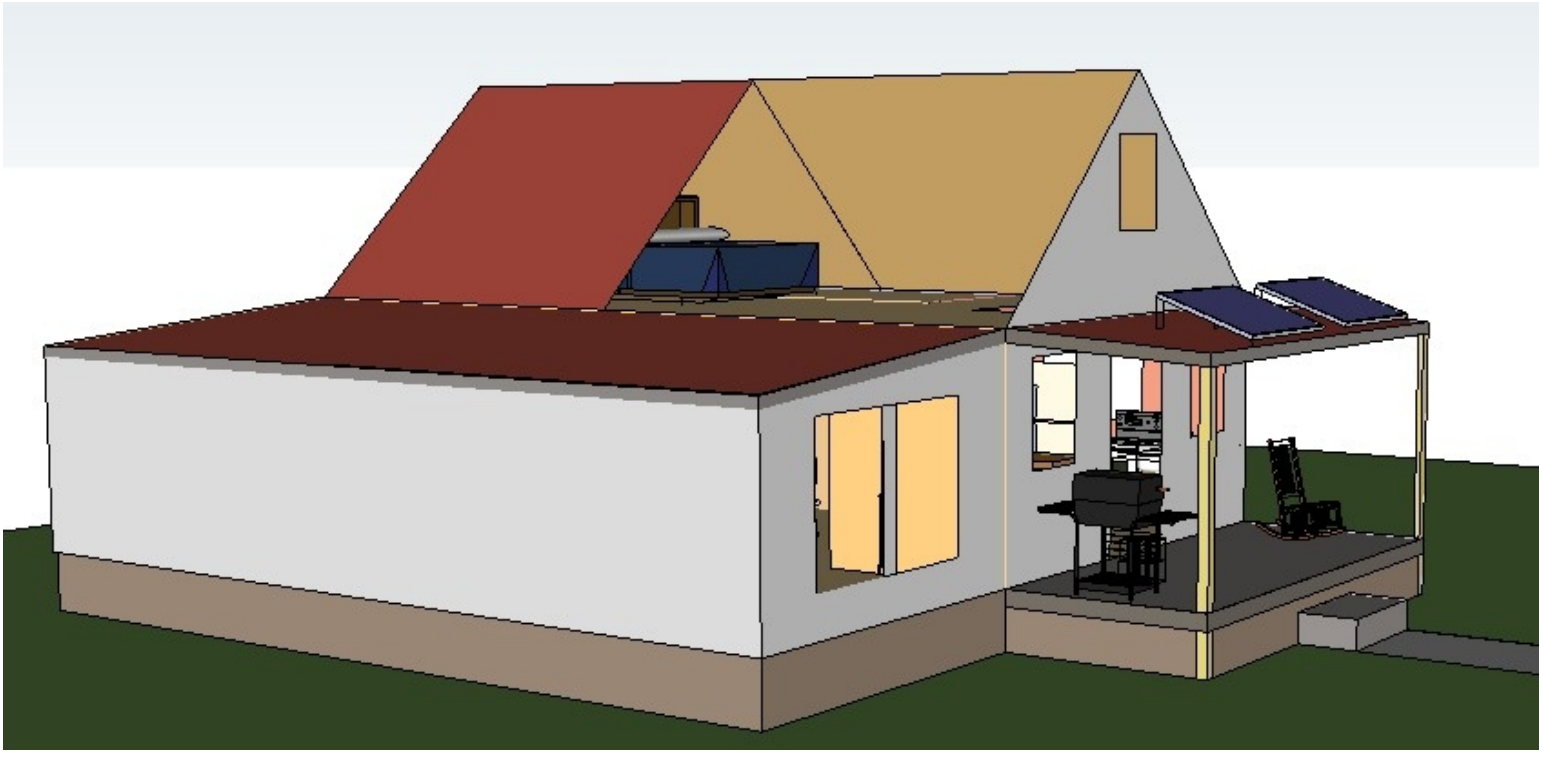


This is the basic framing for an an addition. Follow the same steps in chapter one for framing the cabin, insulation, and roofing.

If you need more room you can also build two cabins end to end.



Additions can be added as needed



Here are three cabins built by customers based on my cabin plans for ideas

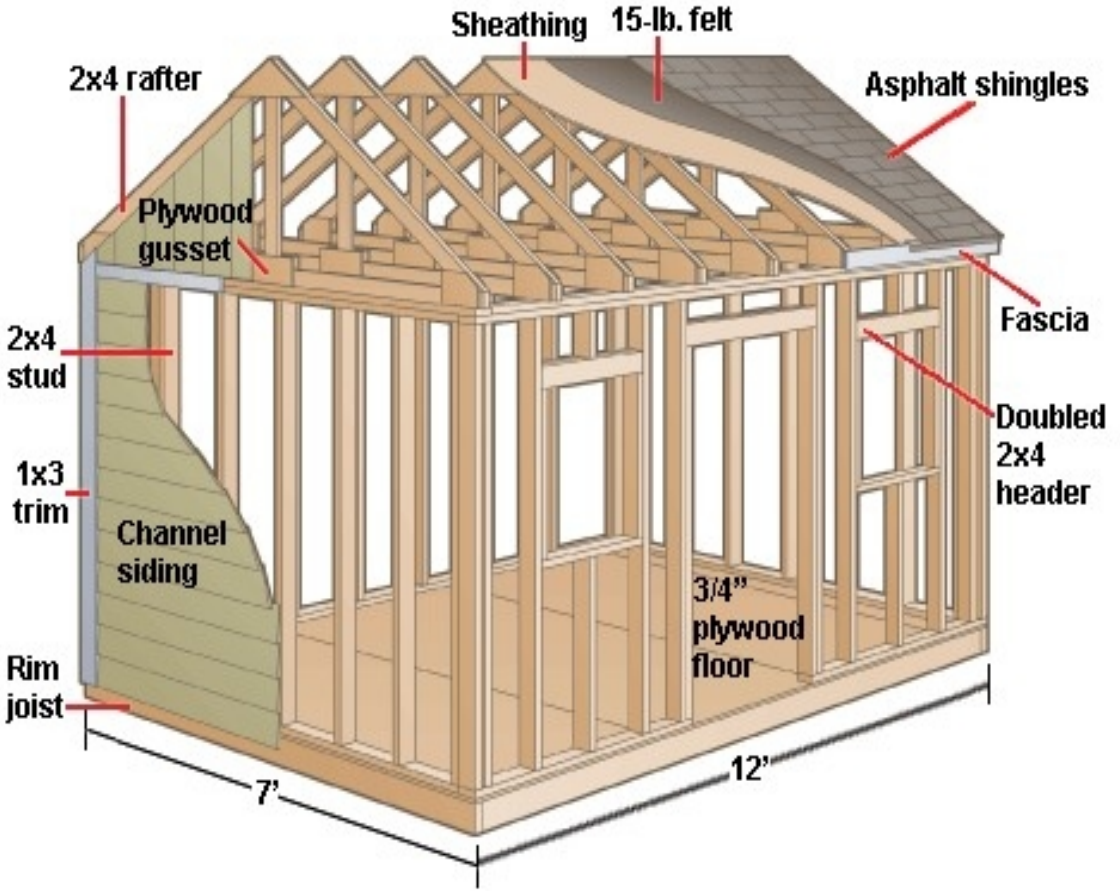
Thanks Tina Petry, father, husband and sons for sharing these pictures of their cabin.

This cabin was built by Jesse McVey. Check out the cool interior work and stag horn cabinet pulls.

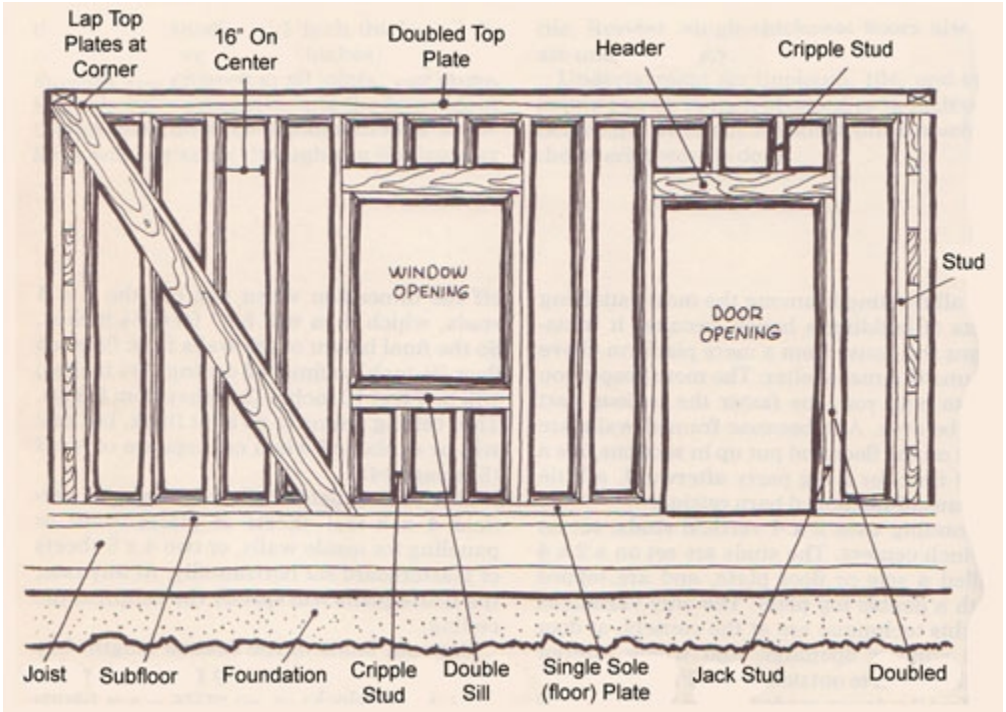
This is Natasha's cabin in BC Canada. She used piers for her foundation and modified the cabin to be more disability friendly. I love the exterior siding and windows.

The cabin can be finished with any materials you like and window and door placement can be easily modified to fit your needs.

My gratitude and thanks to these wonderful people for sharing their cabins!



Basic Shed Construction



Basic wall Construction

3D Cabin Modifiable

If you like the cabin and want to see it in 3D and make modifications it is available as a Google Sketchup file.

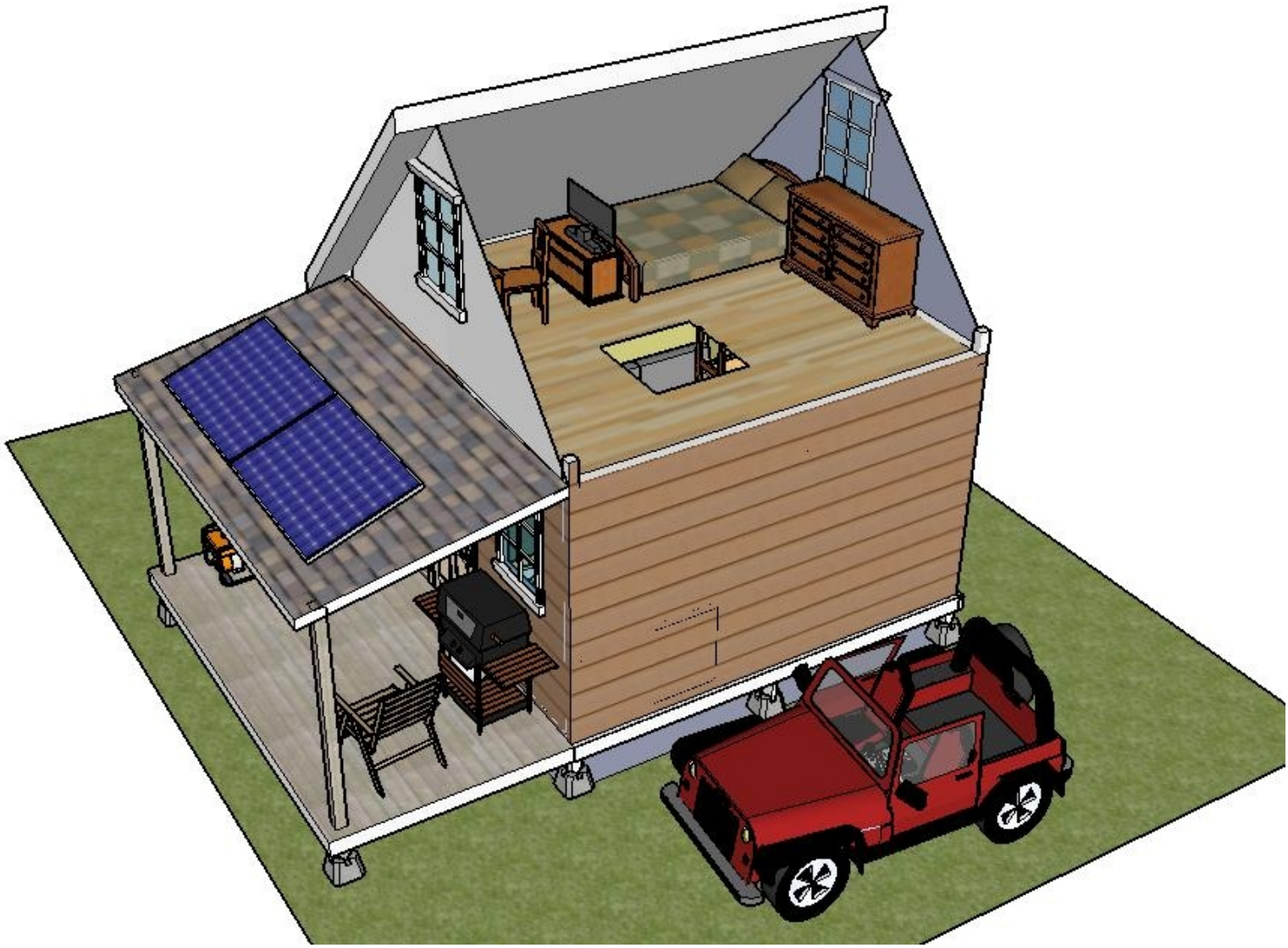
You will need to download and run Google Sketchup which is a free program available here:

Google Sketchup Download

Then download the 3D cabin file and SAVE it. You can then view the cabin in 3D and make any modifications you want including building on additions, changing materials, and adding or removing furnishings to suit your taste.

Sketchup is an easy to use design program so just play around with it and make the Cabin exactly the way you want it. You can design your entire homestead including landscape using Sketchup!

Download the 3D Cabin file here: 3D Cabin Download



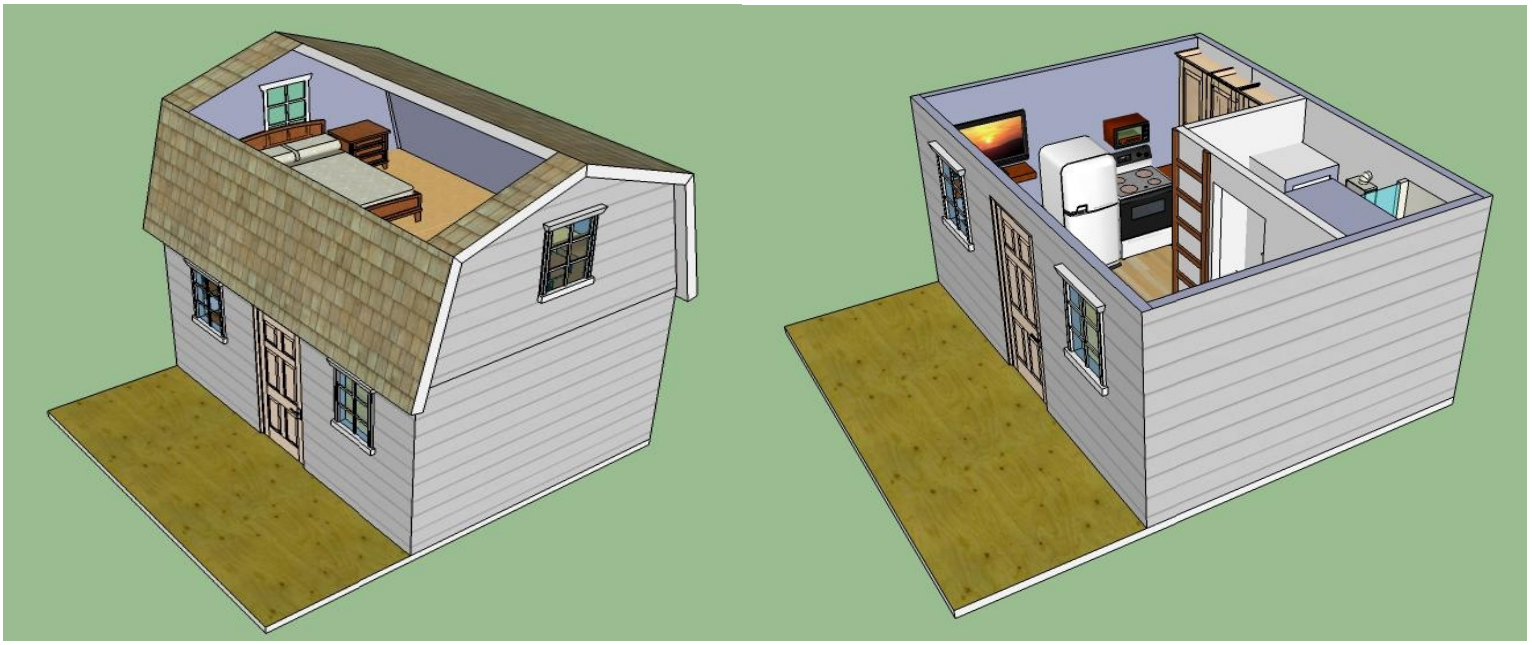
3D 12X16 Barn Cabin Modifiable

Here is a 12x16 Barn style Cabin that may also work for your needs. You can build this cabin using the same techniques described for he 14X14 Cabin or you can buy a 12X16 shed pre-built at many stores like Home Depot or Lowes that could be converted to a Cabin.

You will need to download and run Google Sketchup which is a free program available here:

Google Sketchup Download **3D 12X16 Cabin Download**

Then download the 3D cabin file and SAVE it. You can then view the cabin in 3D and make any modifications you want including building on additions, changing materials, and adding or removing furnishings to suit your taste. Sketchup is an easy to use design program so just play around with it and make the Cabin exactly the way you want it. You can design your entire homestead including landscape using Sketchup!



This Cabin is designed with a Barn style roof but could easily be changed to a standard pitch roof oreven a shed style roof for a single story Cabin. Barn style roofs take more material and cost a bit more but provide additional head space in the loft. Click pics below for prices from Lowe's

Heartland DIY Country Manor 12 x 16 Wood...

$2,949.00

Summary:

It took me two weeks working by myself to build my cabin and that could be done even quicker If you have a few buddies to help you get it done. I highly recommend help with the roof rafters and roofing for safety reasons.

Some tips to help you:

I suggest you camp on your property for at least a week before building to get a feel for where to build your cabin. Get to know the land intimately. Know where the sun rises and sets and where the high and low spots are.

The prettiest spot near a creek may turn into a nightmare when spring run off swells that pretty creek into a raging river that washes away your cabin. High on a cliff may look appealing but that is where the winds will blow in winter and may make hauling in supplies very difficult.

Don't be so quick to remove the natural growth from you land. Those trees, scrub brush and weeds are what is keeping your soil in place and without it your piece of dirt will dry up and bow away or be eroded by rain and run-off. Trees take many years to grow so only remove as necessary.

Buy your building materials in bulk if possible and ask for the bulk discount and maybe even get them to deliver the materials to your land. Use recycled materials wherever possible but don't waste money on bad windows and doors you will have to replace down the road.

A cabin will only last if it has a good roof and foundation. Take time to do these right. Good Insulation and weather proofing the walls from wind and water penetration will save you on heat and cooling.

My most useful tool for building the cabin was my generator. Buy or use a good one and keep it oiled and tuned up. After the cabin is built you can use it for power until you get your solar/wind system installed and then again for running larger appliances like microwaves, washing machines and power tools for working around your homestead. Electric tools, chainsaws, and other electronics may not fit your lifestyle and that is OK but it sure makes the work easier and faster.

If you will be using wood heat you need a steady source for wood so figure out where you will get it first before purchasing and installing a wood stove. The same goes for propane and you need to know where to access it and have more than one source.

Water is an absolute must have and if you will be drilling a well or hauling in water do your research ahead of time. You also have to have a viable plan for disposing of gray water from showers and sinks and waste from toilets before you even consider building a cabin.

DO NOT rush in to any project this size only to find out your time and money was wasted because codes prevent you from building. Contact the county agency and research all relevant codes BEFORE you purchase the land or start building!

Chapter Two
Choosing Your Cabin Appliances

Before building your cabin you should decide how you intend to use the cabin.

Will it be a permanent year round home, vacation cabin, or rustic retreat ?

If you will only be using the cabin seasonally you might want to keep furnishings and appliances to a minimum. Do you need an indoor shower, sink, etc. ?

If you will only use the cabin for vacationing you might want to just bring an ice cooler, camp stove and porta-potty when you visit.

A permanent cabin used year round will usually requires more permanent fixtures and appliances.

Here are some options to consider:

<u>Heat</u>

If you will be using the cabin in cold weather you will probably want a heat source.

Small wood stoves are a great choice for a cabin if your cabin sits on a wooded lot you may have all the free fuel you need by using dead wood and trimmings or haul and cut your own.

Small cast iron and steel box stoves with a flat top can also be used for heating water and cooking:

Click on image to view prices

Propane

If you prefer a less labor intensive and more consistent heat source propane is an excellent choice.

Propane can also be used to heat water and run a fridge, stove and generator.

To use propane you will need a tank and many propane companies will deliver a tank or you can purchase your own:

Click on image for 100 pound tank

Click on image for 33.5 pound tank

You will also need a propane hose and regulator

Click for more information

For cooking a propane stove can be salvaged from an RV or purchased:

Click on images for more information

For heating water an On Demand water heater works very well or a conventional tank heater. In chapter ## we discuss building a solar water heater:

Click on image for more information

Propane heaters will keep a small cabin very comfortable and the ones without blowers do not require any power source and work best with a small solar electric system.

Click on image for more information

You may also want to use 12 volt appliances directly from your solar electric system:

Some examples from my solar cabin:

I use a propane fridge and my stove is a recycled RV 4 burner w/ oven

I use a propane 20,000 BTU furnace

This is my propane OD water heater

You can visit my website to view many appliances I use or recommend:

http://www.simplesolarhomesteading.com/reccomendedproducts.htm

Summary:

I salvaged almost all of my appliances for my cabin straight from the small camp trailer I was living in while I built the cabin and that may work for you and save some money.

The water tank, water pump, sinks, shower, water heater and even flexline plumbing can all be recycled from a camp trailer for a complete basic plumbing system.

For your lights and gadgets the 12 volt dc lights in a camp trailer will work great or you can find these at any RV supply store or online. If your camp trailer has a battery storage box, and inverter you have the basics for your solar electric system.

Before I had solar I recharged an old car battery from my truck or generator so I had lights and could run the water pump.

If your camp trailer has a propane or DC fridge you can build a box in the cabin to house that and the small propane heaters in camp trailers will heat up the cabin nicely. Propane bottles and connections can also be salvaged from the camp trailer.

I chose not to use wood heat because I have asthma and also wood is scarce and takes more labor to collect, cut and use. If you have ready access to cheap wood then a small wood stove would be an excellent addition to your cabin.

You cabin can be as simple or hi-tech as you prefer but keep in mind that repairs and replacement parts may be scarce and a simple system that works and can be fixed with common available parts will save you time and money.

Furniture can be handmade for that rustic feeling or second hand to save money. I even recycled the mattress and all the curtains, shelves, and cabinets from my camp trailer.

If you do recycle your cabin furnishings from a camp trailer you will probably end up with a stripped camp trailer that makes an excellent spare bedroom, storage or tool shed or can be used for hauling stuff around your homestead or getting supplies from town!

I have purchased old camp trailers like the one below for a few hundred dollars and you may even find one for free if you do a little looking.

Plumbing and Grey Water System

When I first moved in to my cabin I hauled in water and later I hand drilled a shallow water well. I have included plans for drilling a well in Chapter ##

If you will be using your cabin just for vacationing you can easily haul water in for drinking and dishes in a water cooler or barrel.

For a permanent cabin with a water source you will need a few items. I salvaged all of these from my old camper or you can buy them.

20 or 30 gallon potable water tank

12 volt DC shurflo water pump

A double RV sized sink

Shower stall or base

Hooking it up

I put my water tank under the sink with the inlet hose going through the wall to the outside and I can fill it directly from my well or from a rain barrel or from water I haul in.

The tank out line goes to the water pump and from there to the OD water heater, sink and shower.

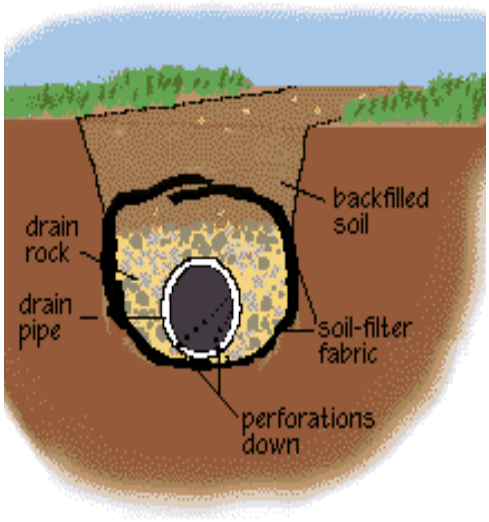
Grey Water

Grey water is water from the sink and shower that can be recycled for use on a garden or flower bed.

You should recycle this water to reduce water use and if you will be using a composting toilet you do not want extra water in your composting toilet but if you are using a conventional septic system you do not have to recycle Grey water but it is still good for the environment.

The simplest way to recycle Grey water from sinks is to put a 5 gallon bucket under the drain and dump it on your garden when it is full. If you want to run the drains outside you can run the drain line directly to a garden or flower bed or use a French drain.

French Drain



What is involved in a successful french drain? Whether you hire it done or try it yourself, here is the process:

- **Cut a channel at least 9″ wide. You can make the depth as little as 9″ if needed to avoid sensitive tree roots, but a foot or more is better.**
- **Slope: Sometimes a french drain is installed in low areas and can only be put in flat. If it ends somewhere that water can go, even this will collect excess water and allow it to flow off site. Ideally a minimum slope such as 1/8″ per foot should be used if possible.**
- **Always use drain cloth. A trench filled with rock will fill in with dirt and be almost useless in two years. As indicated in the picture use the 3′ wide cloth to line bottom of trench. Some simply fill the trench with the drain rock to within 3″ of the top, fold the fabric over and cover with soil.**
- **Three or four inch perforated drain pipe aids in overall performance. Holes go down. Some slid a pipe sock over pipe for extra insurance. It is made of the same soil filter fabric.**
- **Drain rock can be any of a number of types. Rock over 1″ tends to hold in place better than gravel. It is important that the rock contains very little fines, such as found in base material, that can impede drainage. Remember to cover rock with the drain cloth.**
- **Soil for backfilling top should contain sand to facilitate drainage. Some installers will fill the top with a more expensive decorative rock, but this begins to fill in with soil soon enough to make it impractical.**

Sometimes plants in a vegetable garden or flowerbed will need more water than is provided through normal rainfall. Usually at those times a gardener just turns on an outside faucet and waters the garden, drawing on community water supplies, or from a private well.

But-below normal rainfall and predictions that the Northeast may be going through a drought cycle are causing people to find other ways to provide gardens with the moisture they need without using what may become scarce supplies of fresh water.

One method is to use the wastewater, usually referred to as gray water, produced in the home. The following are answers to some basic questions about how to safely use gray water in the home garden.

First, what is gray water?

Gray water is all the non-toilet wastewater produced in the average household including the water from bathtubs, showers, sinks, washing machines, and dishwashers. Although gray water does not need extensive chemical or biological treatment before it can be used in the garden as irrigation water, it still must be used carefully because it usually contains grease, hair, detergent, cosmetics, dead skin, food particles and small amounts of fecal matter.

How much gray water can be used in the home garden?

First, collect only as much wastewater as you will need to meet the water requirements of your garden. The rest should go into your sewer or septic system.

A good rule-of-thumb for deciding how much gray water to use on your garden is that a square foot of well-drained, loamy soil can handle about a half gallon of gray water per week. In other words, if your garden area is 500 square feet, then you can put up to 250 gallons of gray water on your garden each week.

If you can be choosy about the gray water you recycle on your garden, then use shower and bathtub water first, followed in decreasing order of desirability by water from the bathroom sink, utility sink, washing machine, kitchen sink and dishwasher. Water from the kitchen sink and dishwasher is not desirable because of the larger proportion of grease, food particles and other materials it will contain. If there is no way you can avoid using water from the kitchen sink and dishwasher, try to limit the amount of grease and solid food particles that go down the drain. Do not recycle water from a washing machine that has been used to wash baby diapers because it may contain fecal matter.

What about soaps and detergents? Are they harmful to the soil and plants?

Soaps and detergents are biodegradable, but they can present problems when gray water is used over an extended period. The main problem with most cleaning agents is that they contain sodium salts which, if present in excessive amounts, can damage the soil structure, can create an alkaline condition, and can also damage plants.

Avoid detergents that advertise "softening power," because they will have a large proportion of sodium-based compounds. The phosphates in detergents can be good for plant growth, but unfortunately, the detergents highest in phosphates usually contain the greatest amount of sodium. If you re-use washing machine water, cut down or eliminate the amount of bleach you use and do not use detergents or additives that contain boron, which is especially toxic to plants.

When doing your household cleaning, use ammonia, or products that contain ammonia, instead of chlorine as the cleaning agent.

What precautions can I take to protect the soil from damage when I use gray water over a long period of time?

As mentioned earlier, a great danger in using gray water is the build-up of sodium in the soil. You can discover if the sodium levels are high by having the pH of your soil tested. A pH of 7.5 or above indicates that your soil has become loaded with sodium. You can correct or avoid this problem by spreading gypsum (calcium sulfate) over the soil at a rate of two pounds per 100 square feet about once a month. Rainfall, or rotating gray water applications with fresh water, will help leach the soil of sodium and excess salts.

Is there any danger of spreading disease by using gray water in the garden?

Recycled water from the bath, shower, or washing machine could contain organisms causing diseases in humans. However, when gray water is poured onto soil that has an abundance of organic matter, the potentially harmful bacteria and viruses die quickly. If any should survive, it is unlikely that they would be taken up by the roots of garden plants and transferred to the edible portion of food plants. Nevertheless, for safety, you could use gray water to irrigate lawns and ornamental plants only.

How should I apply gray water to the soil?

Whether you carry your gray water to the garden by hand in buckets or modify your household plumbing for direct delivery of water to the area where it is needed, a number of guidelines should be followed in applying the water. They include:

- **If possible, use gray water for your ornamental plants and shrubs and use what fresh water is available for your vegetable garden. If you need to use gray water for irrigating food plants, restrict its application to the soil around plants such as corn, tomatoes, broccoli, or other vegetables of which only the above ground part is eaten. Do not apply gray water to leafy vegetables or root crops.**
- **Apply the gray water directly to the soil surface. Do not use an overhead sprinkler, or allow the recycled water to splash off the soil and contact the above-ground portion of the plants. If you have a drip irrigation system, do not use gray water in it since any solid matter it might contain could clog the emitters in the pipe.**
- **Pour the gray water on flat garden areas; avoid steep slopes where runoff could be a problem.**
- **Apply the wastewater over a broad area; avoid concentrating it on one particular site.**
- **When possible, rotate applications of gray water with fresh water. The fresh water will help leach out any soil contaminants that might be building up.**
- **Apply thick compost mulches to areas where you use gray water. They will speed the natural decomposition of waste residues.**
- **Use gray water on well-established plants only. Seedlings can not withstand the impurities of the waste water.**
- **Do not use gray water, which is alkaline, on acid-loving plants such as rhododendrons and azaleas. Be sure to rotate your use of gray water with fresh water on lawns and fruit trees.**

How can I get gray water from the house to the garden?

Gray water can be transported to the garden in a number of ways, the most basic being to bucket the water from the sinks and bathtub into pails and hand carry it to the garden. More sophisticated systems involve siphoning or pumping water from the bathtub or other deep basins (sumps) to the yard through a garden hose, or removing the trap from the bathroom sink drain pipe and putting a five-gallon, or larger, bucket beneath the sink. If you decide to adapt your plumbing system to allow you to get the gray water to the garden, be sure to have your local board of health inspect your work to insure that no sanitary codes are violated.

Prepared by: Allen V. Barker, Professor; Jean E. English, Graduate Student, Department of Plant and Soil Science

How to build a Rainwater and Grey Water Recycling System

If you live in an area that has rainstorms then a rainwater collection system can be very useful for harvesting water and a grey water recycling system will make your water do double and even triple duty to reduce your homestead water needs.

What is it ?

A rainwater recycling system is simply a gutter collection system and holding tank which can be used for uses like washing clothes, showering, and watering plants. Rain water could be filtered for drinking in an emergency but because of the possibility of contamination and disease I only recommend this water for non-culinary uses.

Grey water is the waste water from your sinks and shower (not toilet or washer) that can be recycled for uses like watering plants by catching it before it goes into your septic system.

Why collect rainwater ?

Groundwater is becoming scarce and well digging can be expensive (see chapter 12 how to dig your own water well) but many areas get frequent rainstorms and that is valuable water that if not harvested will just go to waste running down storm gutters or soaking into topsoil and evaporating. Even a small roof and gutter system like the one on my cabin can collect enough water in an average year to handle basic needs.

How Much Water Can Be Captured?

In theory, approximately 0.62 gallons per square foot of collection surface per inch of rainfall can be collected. In practice, however, some rainwater is lost to first flush, evaporation, splash-out or overshoot from the gutters in hard rains, and possibly leaks. Rough collection surfaces are less efficient at conveying water, as water captured in pore spaces tends to be lost to evaporation. Also impacting achievable efficiency is the inability of the system to capture all water during intense rainfall events. For instance, if the flow-through capacity of a filter-type roof washer is exceeded, spillage may occur. Additionally, after storage tanks are full, rainwater can be lost as overflow.

My cabin has 280 square feet of roof plus 92 on the porch so 372 square feet total. That means I can collect approximately 230 gallons in a 1 inch rainstorm. We average 11 inches of rainfall each year so that's 2500 gallons a year. My average use is 40 gallons per week X 52 weeks equals 2080 gallons a year so my system covers my basic needs.

History of rainwater harvesting

Rainwater harvesting is an ancient technique enjoying a revival in popularity due to the inherent quality of rainwater and interest in reducing consumption of treated water. Rainwater is valued for its purity and softness. It has a nearly neutral pH, and is free from disinfection by-products, salts, minerals, and other natural and man-made contaminants. Plants thrive under irrigation with stored rainwater. Appliances last longer when free from the corrosive or scale effects of hard water. Users with potable systems prefer the superior taste and cleansing properties of rainwater. Archeological evidence attests to the capture of rainwater as far back as 4,000 years ago, and the concept of rainwater harvesting in China may date back 6,000 years. Ruins of cisterns built as early as 2000 B.C. for storing runoff from hillsides for agricultural and domestic purposes are still standing in Israel. (Gould and Nissen-Petersen, 1999).

Advantages and benefits of rainwater harvesting are numerous

The water is free; the only cost is for collection and use.

The end use of harvested water is located close to the source, eliminating the need for complex and costly distribution systems.

Rainwater provides a water source when groundwater is unacceptable or unavailable, or it can augment limited groundwater supplies.

The zero hardness of rainwater helps prevent scale on appliances, extending their use; rainwater eliminates the need for a water softener and the salts added during the softening process.

Rainwater is sodium-free, important for persons on low-sodium diets. Rainwater is superior for landscape irrigation.

Rainwater harvesting reduces flow to storm water drains and also reduces non-point source pollution.

Rainwater harvesting helps utilities reduce the summer demand peak and delay expansion of existing water treatment plants.

Rainwater harvesting reduces consumers' utility bills.

Elements Of A Greywater Irrigation System

- **Greywater source(s) -** Washing machine, shower, bathtub and/or sinks
- **Collection plumbing -** Pipes that transport greywater from inside the house to just outside the house
- **Surge Tank, filter and pump -** Optional elements that add complexity and cost but make the distribution plumbing's job easier
- **Distribution plumbing -** Pipes that transport greywater from just outside the house to locations throughout the receiving landscape
- **Receiving landscape -** Soil, roots, plants, and mulch basins that contain, cover, purify, and use the greywater
- **People -** Those who design, make and maintain the system, generate the greywater, tend the garden and eat the food it produces. People are a critical but often overlooked component of the system

Courtesy of: http://www.letsgogreen.com/greywater-recycling.html

Basic Components

Regardless of the complexity of the system, the domestic rainwater harvesting system comprises six basic components:

Catchment surface: the collection surface from which rainfall runs off

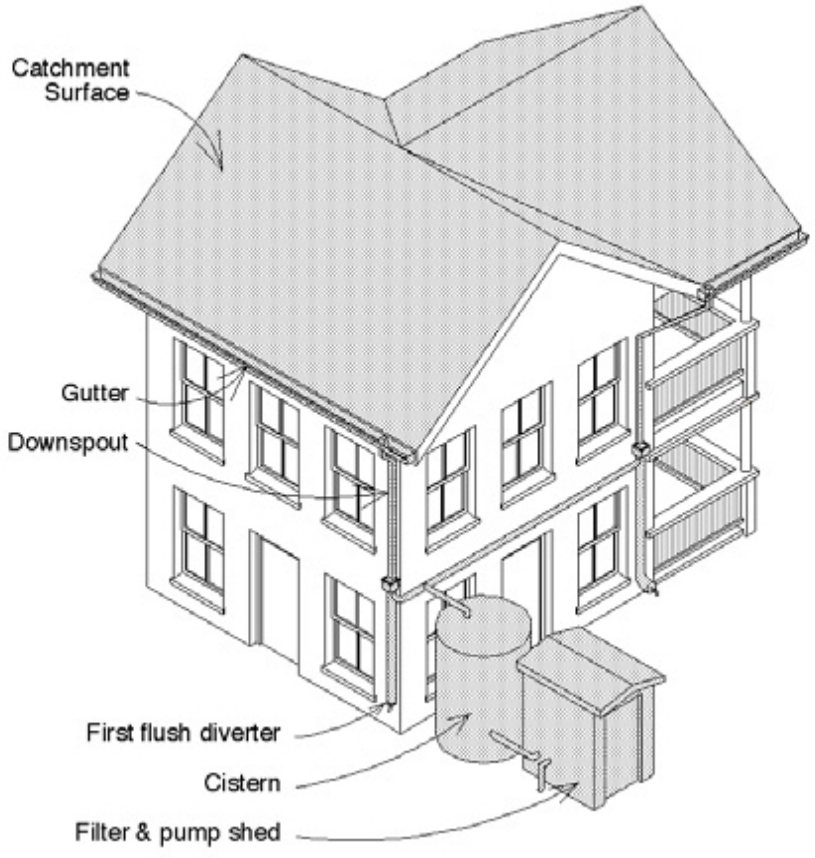
Gutters and downspouts: channel water from the roof to the tank

Leaf screens, first-flush diverters, and roof washers: components which remove debris and dust from the captured rainwater before it goes to the tank

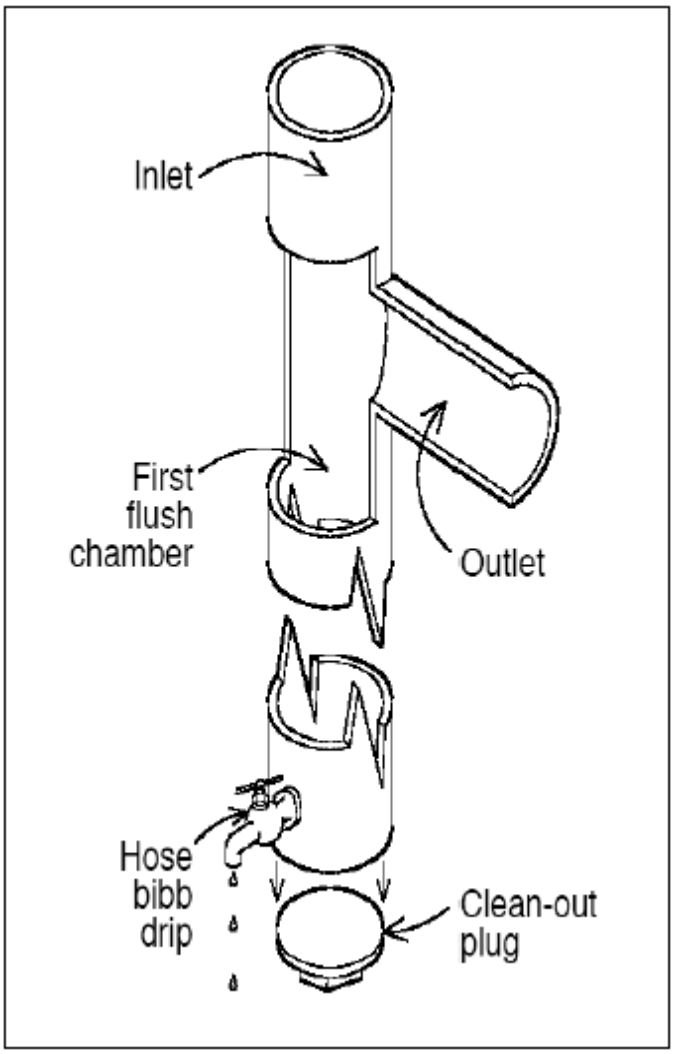
One or more storage tanks, also called cisterns

Delivery system: gravity-fed or pumped to the end use

Treatment/purification: for potable systems, filters and other methods to make the water safe to drink



Picture courtesy of Texas manual on rainwater Harvesting

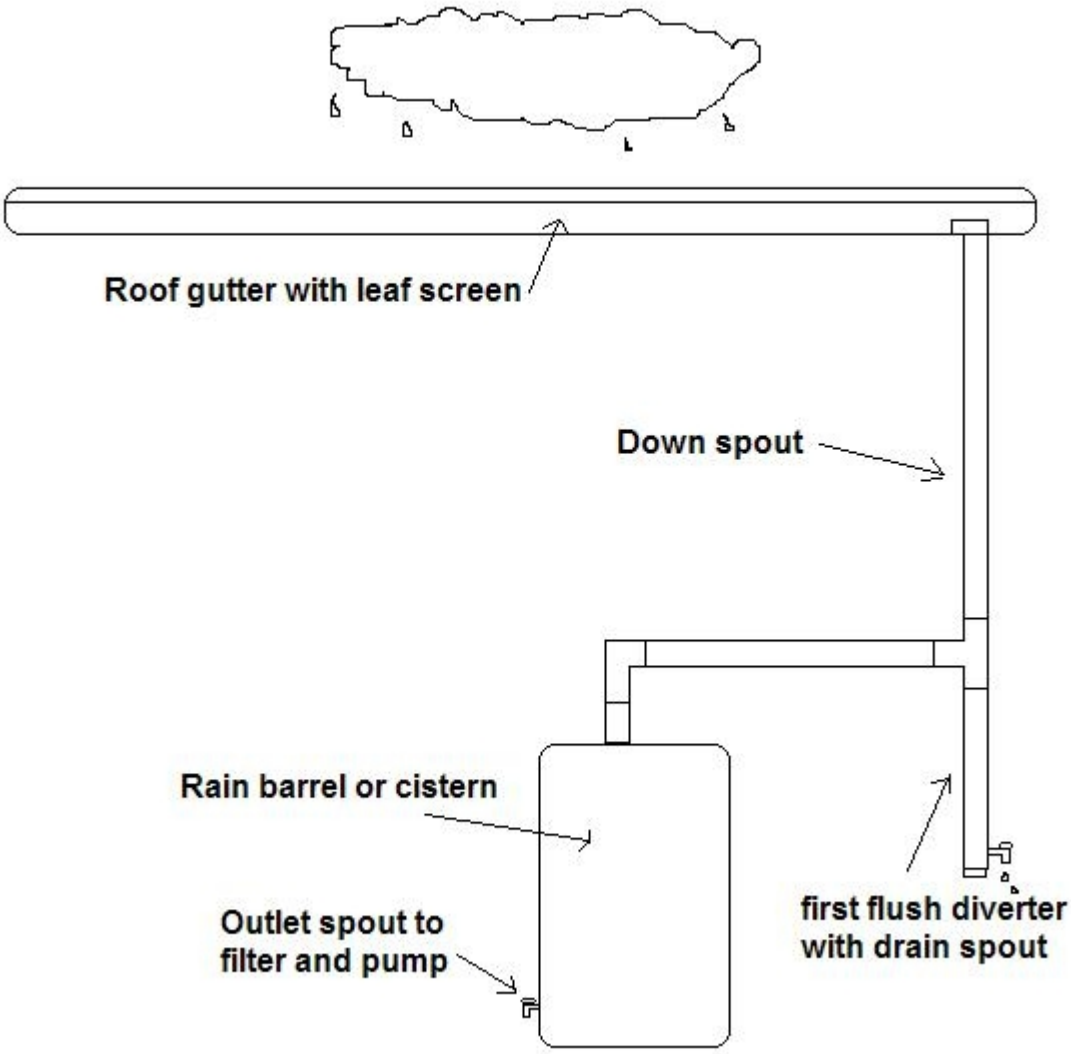


First flush diverter

The first rain run-off from a roof is usually full of dirt and contaminants. To avoid collecting this water build a first flush diverter like the one shown above. The recommended diversion of first flush ranges from one to two gallons of first-flush diversion for each 100 square feet of collection area. The simplest first-flush diverter is a 6- or 8-inch PVC standpipe (Figure 2-2). The diverter fills with water first, backs up, and then allows water to flow into the main collection piping. These standpipes usually have a cleanout fitting at the bottom, and must be emptied and cleaned out after each rainfall event. The water from the standpipe may be routed to a planted area. A pinhole drilled at the bottom of the pipe or a hose bibb fixture left slightly open (shown) allows water to gradually leak out.
If you are using 3" diameter PVC or similar pipe, allow 33" length of pipe per gallon; 4" diameter pipe needs only 18" of length per gallon; and a little over 8" of 6" diameter pipe is needed to catch a gallon of water.

Here is the simple rain harvest system I use. I collect the rain water in a 55 gallon plastic barrel and I attach a hose to the barrel spout or use watering cans to transport water.

I use rain water for watering my garden and cleaning but not for drinking or cooking because my filter system is not adequate for that and I do not want to use a lot of chlorine.



Water filtering

The least expensive is a charcoal cartridge filter which combines a 1 micron filter to prevent giardia and reduce chlorine, lead, and pesticides. These are available at most hardware stores for under $100. Get the best filter you can if you will be using rainwater for potable uses.

Click on images for more information

Tanks

I use a 55 gallon plastic rain barrel but for more water storage you could use plastic, cement, steel, fiberglass or wood tanks. Just remember water is very heavy and a large tank must be placed on firm ground or cement pad or it could tip or collapse.

55 gallon water barrel with drain hose attached. It sits on cement block to prevent settling. Remember water is heavy so support your tanks!

Two 10,000 gallon fiberglass tanks

5,000 gallon polypropylene tanks

Rain water harvesting has been tested and is becoming very common in states like Texas and New Mexico where good ground water is scarce but rainfall is plentiful.
If you build a rainwater system I think you will be very happy with the results the first time a rainstorm fills your barrels!

Click on images for more information

Grey Water Recycling

Grey water is the water that normally runs down your sink and shower but not your washer or toilet. This grey water can be safely recycled for non potable uses like watering gardens and other uses like flush water for your porta-potty.

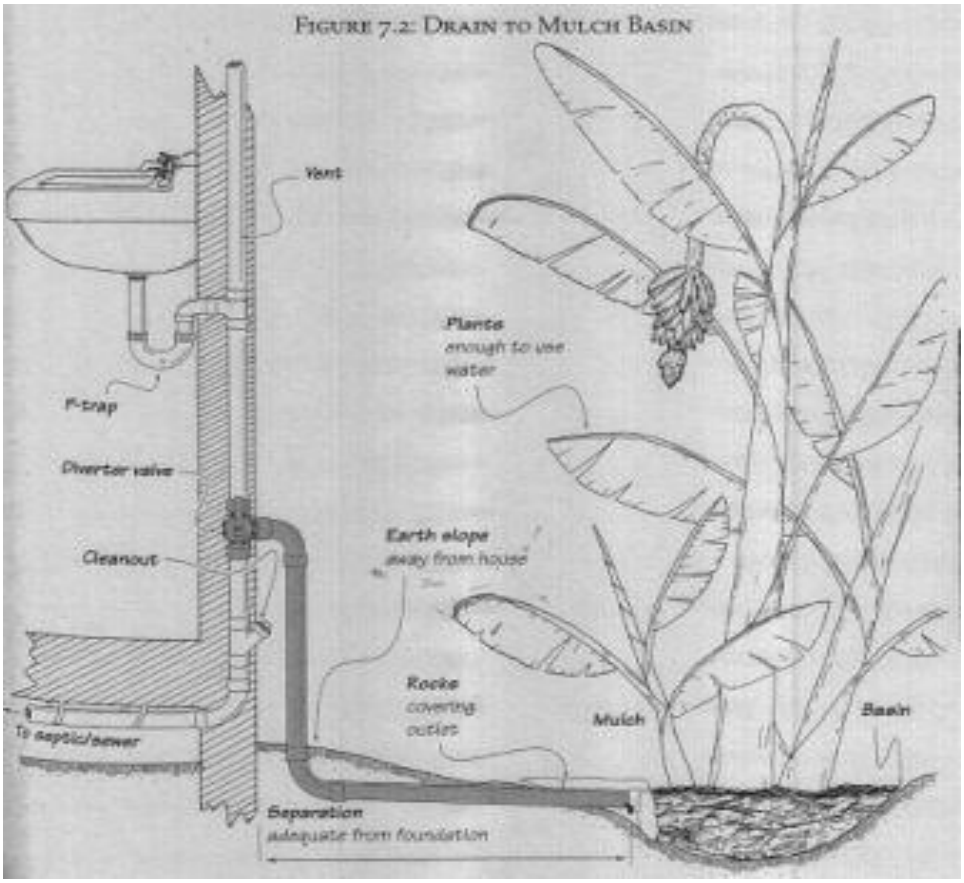
Grey water generally has few dangerous contaminants and if filtered it is not likely to pass on disease or dangerous bacteria to your garden plants.

The easiest grey water system and the one I use is simply to disconnect your sinks from the drain trap and put a 5 gallon bucket under the drain pipe. You will need to monitor this bucket and do not let it overflow. This will make you more water conscious which will also result in less water waste.

I filter this water by pouring it from one bucket to another through several layers of cheese cloth or old t-shirts. Then it goes onto the garden. In the winter this water is used to fill the flush tank on my porta-potty. Extra grey water goes on house plants.

You can buy organic biodegradable soaps but if you minimize the soap you use it won't effect the water quality for gardens. Just pour the water on the soil not the plants and choose different pour locations each time and the soil will filter out the soap.

If you can get double or even triple duty from your water you will waste less water which means you won't need to haul or harvest as much.



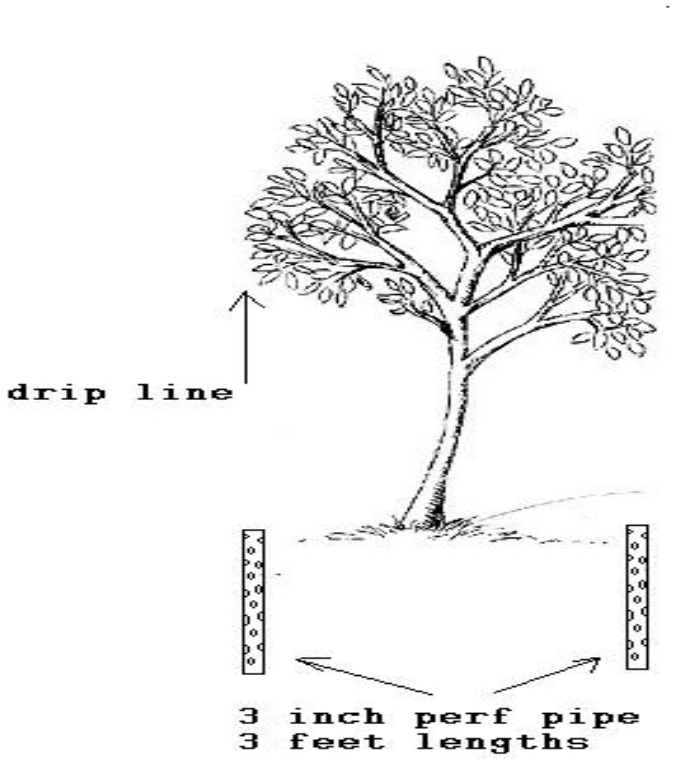
My grey water and compost recycling system

I have found a great way to recycle my grey water, rainwater, and compost to feed my trees and garden. Plants and trees can absorb more nutrients when water and nutrient rich compost is placed directly at feeder roots.

<u>Trees</u>

I have fruit trees and shrubbery that loves a good watering and feeding but pouring water on the surface usually results in run-off and evaporation waste and most of the water never penetrates down to the feeder roots where the trees need it.

To fix this problem I use 3 foot lengths of 3 inch perforated pvc sewer pipe placed in the ground right at the tree and shrub drip line as shown below.

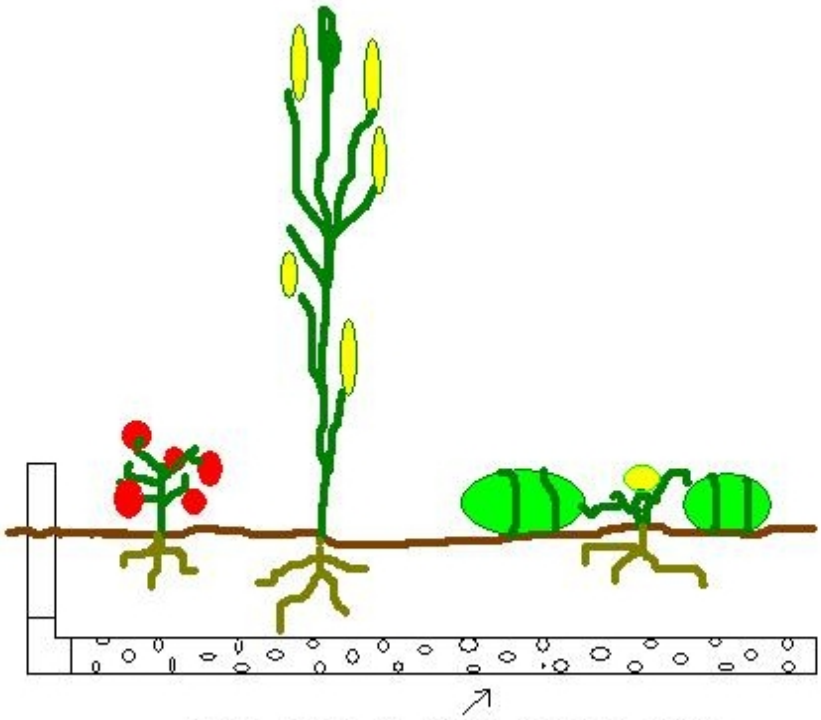


Place the perf pipe at the drip line which is the ring of outermost leaves. This is where the feeder roots will be located and where the water and nutrients will do the most good. Mix 1/3rd rich compost and 2/3rds water in a bucket and pour this mixture into the open end of the perf pipe. It will saturate through the openings and feed the tree. Add this compost tea to the trees only when actively growing from spring to early fall. If pipe becomes clogged just move it to a new spot around the drip line. Use more perf pipes for large trees.

NOTE: do not use grey water or compost contaminated with weed killer or you will kill the tree.

Garden

To feed your garden place a length of perf pipe in your raised beds or under garden beds at a depth of 1 foot.



Mix 1/3rd rich compost and 2/3rds water and pour this down the pipe spout to feed plants. Commercial plant food can also be used. I water my garden every other day and add compost to plants just once a week and watch out for nitrogen burn if you add too much.

NOTE: do not use grey water or compost contaminated with weed killer or you will kill the plants.

Using perf pipe is a great way to feed trees and plants and can be used in flower beds and around shrubs as well. Your plants get food and water and you are recycling compost and grey water safely back into the soil instead of into a septic system or landfill.

4 inch by 10 foot perf pipe- click image for price

Summary:

When I first moved to my land I hauled in my water in 5 gallon water tanks to refill my camper water tank and water is free at many gas stations or for a small fee at an RV station. For a Cabin being used for vacation or intermittently you can haul in water.

For long term water needs you can pay to have water hauled in to fill a tank, harvest rain or drill a well if you have good ground water.

Before you purchase land check with the surrounding neighbors and county to see if a well can be drilled in your area and how deep the water table is. If the water table for shallow wells is under 50 feet you can hand drill your own well. If it is deeper you will need to hire a well driller which can be very expensive.

Rain water can be harvested but some states and counties no have laws regulating rain harvesting so do some research before planning to use rainwater. Generally speaking rainwater is best used for gardens and non-culinary uses and not for drinking because of the potential for bacteria.

There are good filter systems available for cleaning rainwater for potable use but they are expensive.

If you are going to be harvesting rain water for washing clothes or showering I recommend you use a metal roof on your cabin that reduces contaminants in the water and a first flush diverter and good filter system.

My rain water system is used primarily for watering the garden with a drip irrigation system but also is a backup system in the event my water well failed for some reason.

Some states and counties have codes for handling grey water from washing machines, sinks, and showers so again do your research before you plan a grey water system.

Grey water is generally safe to use for lawns and fruit trees but avoid using it on leafy vegetables or plants that grow their fruit or tubers underground.

You can reduce contaminating the soil by using a heavy mat of compost such as straw around plants to filter the water.

Grey water drains and French style drains should be placed down stream from your water well to avoid contamination.

My grey water system consists of a bucket under my kitchen sink catch the drain water which I pour directly on my garden and my shower drain is a 1 inch drain hose that runs out onto my lawn. I run the washing machine water into a simple french drain which is a 3 foot deep hole filled with gravel.

Avoid using anti-bacterial and heavy duty detergents which will kill plants and leach into the soil.

How to drill your own water well

One of the most important homestead resources is water. If you live next to a city water hook up water probably isn't much of an issue but most homesteads are built on land far from such luxuries. If you are lucky enough to have a well already on your property then you are lucky indeed, but if not, then you will need to haul water to your home, recycle rainwater, or drill your own water well.

Hauling Water

If you live near a town or city or have nice neighbors you may be able to haul all the water you need for your homestead. I hauled water for the first two years I lived in my cabin. I purchased several 5 gallon water barrels and once a week when I went to town I stopped at the local gas station and filled them up. I bought all my gas and a lot of groceries at the station so the water was free.

I had installed a 25 gallon water tank under my sink and set it up so I could fill it from outside through a spout similar to an rv setup. I just dumped the barrels into my tank.
This 25 gallons was enough to wash dishes, cook, clean, and shower for one person for a week. If you have more people you will need to size your tank accordingly.

If you want to haul more water each trip consider buying a poly water tank that will fit in your truck bed or on a trailer and haul your water that way.

Collecting Rainwater

This is discussed fully in another chapter

Drilling a well

How do I know if there's water down there ?

In many areas water may be as close as a few feet under your homestead or within a short distance from the surface. The best way to determine if a water well is possible on your homestead is to consult your neighbors and see if they are happy with their well and how deep they had to go to hit clean water. Your local agriculture dept. can help and ask your local well driller for information (but don't tell them your drilling your own!)

I will show you two methods for drilling a water well. I used the first method and I have seen and helped others use the other method so I know they work.

SAFETY NOTICE

Because of the potential risk of cave-ins, gas pockets, and falling objects digging an old fashioned pit well is absolutely not encouraged! Before drilling a water well contact your local utility company and have them come out and mark utility lines on your property. This is usually free and if you do not do it and rupture a buried line you will be responsible for damages and could cause injury or death.

When driving a sand point well be aware the driver you are using is heavy and can do serious injury or cause death if it slips off the well pipe and hits you or someone else.

Always have your water checked by the health department before using. Ground water can be contaminated by pesticides, nitrates, fuel, or bacteria from raw sewage.

Sand Point well drilling

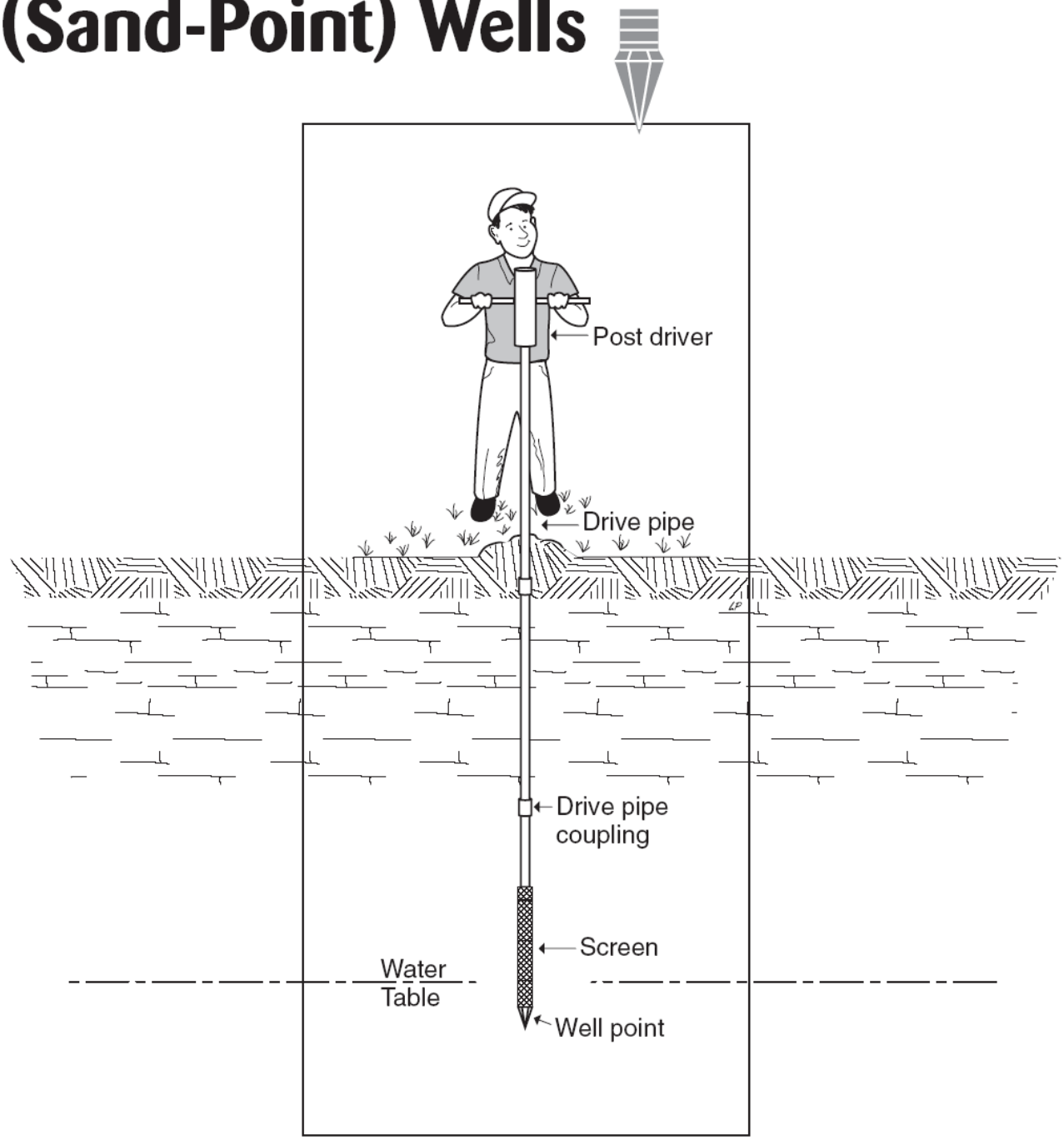
I harvest rain water for much of my water but decided to drill my own water well for agricultural use and in the event rainfall was not sufficient. After much study I decided the sand point driven well would be easiest to complete and easiest on my wallet.

I drove my well approximately 25 feet in two days and it provides about 10 gallons of clean water per hour. I use a hand pump but a 12 volt dc pump would be nice.

You can hand drive a sand point up to 50 feet without too much effort but beyond that distance you will be working hard. For a deeper well consider the powered well drill discussed later in this chapter.

The following information and pictures are provided courtesy of Wisconsin Dept. of Natural Resources. The information is for Wisconsin well codes but should be adequate for most states. Always check your states well codes before drilling a water well.

Driven Point (Sand-Point) Wells



A driven-point well – sometimes called a "sand point" – is a small diameter well made by connecting lengths of 1-1/4" 2" diameter steel pipe together with threaded couplings. Threaded to the bottom of the string of pipe is a drive-point well screen. The screen is usually 2 to 3 feet long with a hardened steel tip or "drive-point" at the bottom. The purpose of the screen is to allow groundwater to flow into the well but keep the surrounding sand out. Water can then be pumped up through the pipe to the surface. The hardened steel drive-point tip allows the well to be more easily driven into the ground. The pipe and drive-point resemble a long spear.

Installation of a driven-point well begins by driving the point and a single length of pipe into the ground. A special fitting called a drive cap is threaded onto the top of the pipe to protect the pipe threads while driving and to prevent contaminants from entering the pipe. Sometimes a shallow "starter hole" is dug or augured at the ground surface to accommodate the pipe lengths and facilitate the starting of the driving process. Driving is often done by hand using a post driver – a short length of weighted steel pipe with handles. Some well point installers use mechanical, motor-operated equipment with a tripod and pulley set up to raise and lower the heavy driver. Sections of steel pipe are added as the pipe is driven deeper into the ground. This is continued until a sufficient depth below the water table is reached.

In many areas a driven point well can be an alternative to a larger diameter drilled well. Installed properly using a high quality drive-point, it can provide an adequate supply of safe drinking water, especially for cottages and many residences. However, because of installation limitations, driven-point wells are usually only found in areas having permeable sandy soils and a high water table. These same conditions can make both driven-point and drilled wells and shallow groundwater susceptible to contamination from land use activities. Contaminants, especially chemical contaminants, can easily migrate down through permeable sandy soils, enter the groundwater and move into a well. But if properly located and constructed, and taking into consideration the land use in the immediate area, driven-point wells can offer protection from most types of contaminants, especially biological contaminants like bacteria.

Sandy soils alone will not guarantee successful installation of a driven point well. If the water table is deep, it may not be physically possible to drive the well point deep enough to reach it. Large boulders or layers of tightly compacted soil like clay or "hardpan" may be encountered that effectively stop the driving process. Further, though clay can hold a lot of water, the clay particles are too closely packed to allow water to flow through it into a well.

Local governmental agency offices, such as the Natural Resources Conservation Service or County Zoning, are other sources of information about local conditions, as are neighboring property owners who already have wells, and, of course, your local water well contractor.

Depth to the water table is another very important consideration when installing a driven-point well. Although 1-1/4" diameter well pipe can be used when the water table is less than about 20' below the ground surface, 2" diameter pipe must be used when the water table is deeper than 20'. This is because different pumps and pumping equipment vary in their ability to draw water from various depths. A shallow well pump can only draw water from a maximum depth of about 20', and for these shallow water table depths, 1-1/4" diameter well pipe is sufficient. A deep-well pump installation is necessary if the water table is deeper than about 20'. Two-inch diameter pipe is necessary to accommodate a jet and packer assembly to be installed in the well pipe itself. This assembly allows the water to be drawn from depths up to about 100'.
However, be aware that pumps lose efficiency as the pumping depth increases.

Water use is another factor to consider when deciding what type of well to install. Many homes today have numerous modern conveniences such as automatic clothes washers, dishwashers, garbage disposers and two or three bathrooms. Some people water gardens and lawns. All create increased water demand, often at higher pressures. If higher water use is anticipated, a drilled well with a submersible pump installation is often a better, more energy efficient alternative to a driven-point well.

Who may construct a driven-point well?

You do not have to be licensed to install driven-point wells. Anyone may install these wells provided there is no preliminary excavation or starter drillhole constructed deeper than 10 feet before driving of the point begins. Further, the work must be done in one mode of operation. That is, the screen must be attached to the pipe before the assembly is driven into the ground.

A pump for a driven-point well must be installed by a licensed pump installer, except when the pump is installed by the owner for his/her residence. The pump must also be installed according to the code requirements no matter who installs it.

For what types of uses are driven-point wells allowed?

Driven-point wells are allowed for the same uses as are private drilled wells, including:

▼ Private residential wells serving 6 or fewer homes and serving fewer than 25 year-round residents.

▼ Non-community water supplies such as restaurants, taverns, and gas stations, etc., but not schools. (School water supplies require DNR approval and drivenpoint wells are not usually allowed.)

▼ Non-potable wells– wells not used for drinking or sanitary purposes. (Non-potable wells must be installed according to the same standards as potable wells).

Where must a driven-point well be located ?
Highest Point on Property

▼ The well must be located on the highest point of the property consistent with the general layout and surroundings if reasonably possible, but in any case the well must be protected against surface water flow and flooding and not be directly down slope from a contamination source on the property or on an adjacent property. The well may be side gradient from a contaminate source provided that surface water that flows over the contaminate source does not flow within 8 feet of the well.
Basement Location Prohibition

▼ The well must not be located in a basement, unless it is installed in a walkout basement, i.e. a basement that is at ground grade on one side of the house.

▼ 8 feet from a “clear water drain” (for example: a rain water downspout outlet or foundation drain discharging to the ground).

▼ 25 feet from a septic or holding tank.

▼ 25 feet from a lake, pond or ditch.

▼ 50 feet from the nearest edge of a septic soil absorption system or mound system.

▼ 50 feet from municipal sanitary sewers, private collector sewers, or storm sewers.

▼ 50 feet from the nearest existing or future grave site in a cemetery.

▼ 50 feet from animal yards.

▼ 100 feet from any buried petroleum tank including associated piping, except that only 25 feet of separation is required for a buried fuel oil tank if the tank is used only for private residential heating.

▼ 250 feet from an absorption, storage, retention or treatment pond, sludge disposal area, ridge and furrow system, or spray irrigation waste disposal site.

▼ 1,200 feet from any existing, proposed, or abandoned landfill site.
Screen replacement

▼ The well must not be located in an unapproved pit. Pits for new wells have been prohibited without special approval since April 10, 1953. A pit is also not a sanitary location for a well. A pit can easily flood and contaminate a well.

▼ The well must not be installed in a floodway. A floodway is that part of a river valley floodplain that becomes inundated with the actual fl owing floodwater during the regional 100-year flood.

▼ The well may be installed in a flood fringe of a river floodplain if the top of the casing pipe is terminated at least 2 feet above the 100-year regional flood elevation at the well site. (The flood fringe is that part of the floodplain that may become inundated with stagnant water during the regional flood.) (Floodplain maps can be obtained from DNR regional offices or from your County Zoning Department.) Separation Distance Requirements

▼ The well must be properly separated from sources of well contamination by the minimum "setback" distances as specified by the well code. For example the well must located be at least: 8 feet from a cast iron or acceptable plastic building sewer pipe or 25 feet from building sewers made of other materials.

What are the well construction requirements?

▼ Minimum Depth: The string of well casing pipe–not including the screen–must extend to at least the 25-foot depth or to at least 10 feet below the static water level, whichever is the greater depth. This is the same minimum casing depth as required for private drilled wells. (The static water level is the normal depth of standing water in the well before the well is pumped.)

▼ Casing Pipe: The well casing pipe must be steel or steel-galvanized and must meet the well code specifications for dimensions and weights and the appropriate ASTM or API standards. (ASTM A53; A106; A589 or API 5L; 5LX; 5D or 5CT. One of these standards designation must be either marked on the pipe or available from the supplier.)

▼ Screen: Any standard metal drive-point screen may be used for driven-point wells. Plastic screens may not be used for driving. The screen does not have to be continuous slot. However, screens having a lead content of greater than 8% by weight also must not be used. Experience has shown a high quality, continuous-slot stainless steel screened well point will provide efficient trouble-free service for the longest time.

▼ Minimum Diameter: There is no minimum diameter for driven-point wells installed with a "shallow" well pump. Atmospheric pressure of about 14.7 pounds per square inch allows a "shallow-well" pump to "pull" water up from a maximum depth of only about 20 feet *(Figure 2)*. However, if you know the pumping water level will be deeper than about 20 feet, then you must use drive pipe having a minimum diameter of at least 2 inches. This is necessary because the drive pipe must be large enough to accommodate a "packer-jet assembly" to be installed within the pipe to enable the pump to "pull" water up from a greater depth. (See Figure 3). Remember, you are not allowed to construct a pit to get the pump closer to the water table to enable you to use a shallow-well pump.

▼ Termination Height: The well casing drive pipe must be terminated to extend at least 12- inches above the permanent ground grade. If you plan to do landscaping around the well, be sure to leave some extra pipe so the final pipe height is at least 12-inches above the ground.

▼ Cap: The top of the drive-pipe must be sealed with a vermin-proof cap such as a threaded cap that will prevent the entry of insects and mice. Many pumps are directly connected to the well pipe as, for example, in Figure 4. A sanitary well seal with compressible gaskets must be used for such installations.

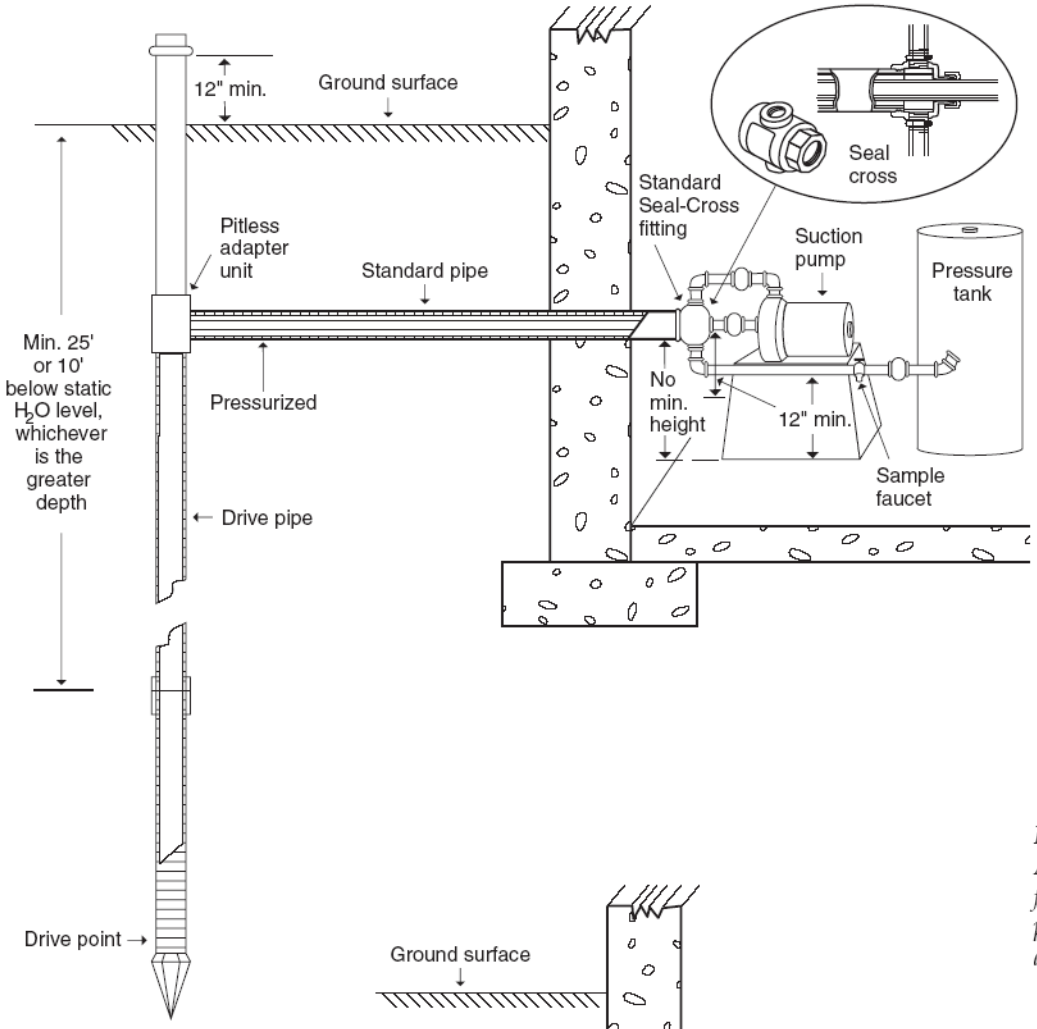


Figure 2. Shallow-well pump installation.

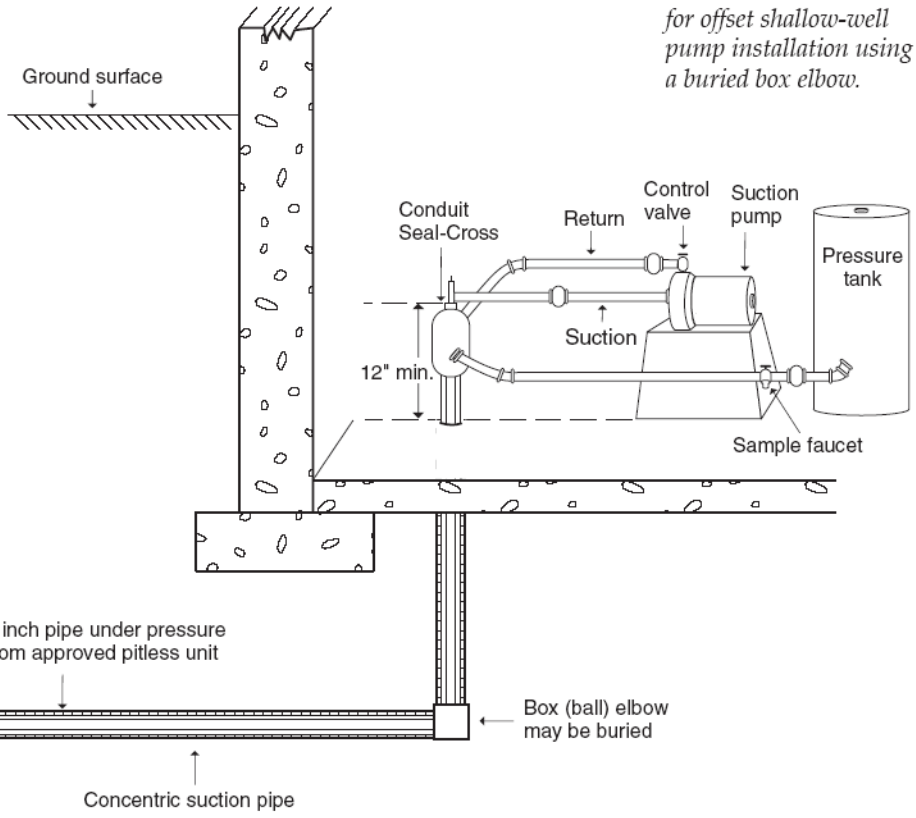


Figure 2a. Alternative installation for offset shallow-well pump installation using a buried box elbow.

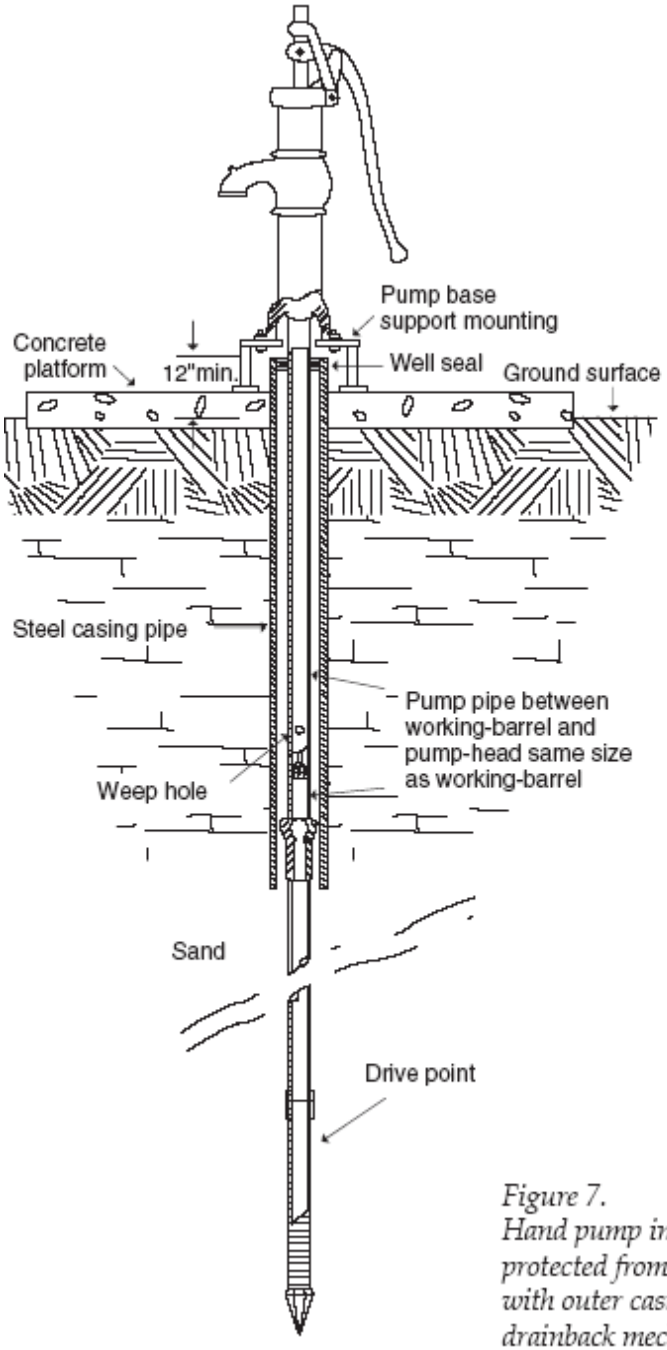


Figure 7.
Hand pump installation protected from frost with outer casing and drainback mechanism.

Here is a picture of my sand point well and my driver. I used 6 lengths of 5 foot 1 1/4" steel pipe, one drive caps, one sand point and a pitcher pump. The well hole must be sealed with cement to provide a good vacuum for the pump.

A pitcher pump will hold its prime for a few hours but always keep a full pitcher of water nearby to prime the pump if necessary. These pumps were used by most original homesteaders and you would find them right in the kitchen by the sink. There is something very satisfying about pumping that handle and pulling fresh water right out of the ground.

<u>COST (2007 prices)</u>

(1)	**Stainless steel drive point with 60 gauze screen wrap**	**$ 62.95**
(6)	**5' lengths of 1 1/4" galvanized steel drive pipe**	**$ 214.50**
(1)	**cast iron drive cap**	**$ 19.35**
(1)	**pitcher pump**	**$ 35.00**
(1)	**bag quick set cement**	**$ 9.00**
	Total for my 25 foot well	**$ 340.80**

Resources for sand point well parts is available in the resource guide

Drilling a water well with a powered drill

If your water table is not very high (more than 50 feet deep) or you want to drill deeper to hit more plentiful water then I would suggest a powered water well drill

Another way to drill your homestead water well is with one of the water well drills available from several companies on the internet, Ebay, or for rent at your local tool rental company. I have assisted drilling with the RockMaster pictured below and was very impressed with its speed and ease of use. It is well made and heavy duty enough for most homestead drilling.

These units can be expensive to buy (starting at $2000) but you might throw in with other homesteaders, rent one, or consider going into business drilling water wells for your neighbors to pay for the equipment.

There are different set-ups depending on the type of equipment but most powered well drilling equipment is similar in their operation. Read the equipment manuals before drilling and follow all safety recommendations!

These units have wheels to roll them to your location and a sturdy base

How they work:

Powered water well drills can be set up in limited space and are good for drilling a water well next to a pre-existing structure. They are pretty much self contained and the frame and drive motor are married together. The motor will raise and lower using a cable or a slide apparatus.

You will usually start a guide hole with a clam shell digger. Your first length of pipe will be the drill bit and is attached to the motor with a wrench or quick release. The drill point is lowered into the hole for drilling and when it has reached ground level it is detached and another length of pipe is connected and the process continues.

This kind of drilling requires a water source to flush the drilled soil from the well hole. You could use a neighbors hose or a couple of 55 gallon barrels should be sufficient.

A mud pump will be used to recycle the water through the pump and down the casing to flush out the debris. You will need a small pit to catch the water that flushes out of the well hole and this water will be recycled back down the well.

When the water temperature coming out of the well gets colder or you see less mud and clearer water then you have probably hit a ground water source. You will want to drill another 5 to 10 feet to be sure the well screen is into the water bearing strata.

You will need some drilling mud (bentonite) which prevents the well hole from collapsing and you will need some pipe wrenches, Teflon tape, gasoline and oil for the pump and drill.

What's an artesian well ?

If you are lucky enough to live near a mountain your ground water may be under pressure as it follows gravity to your homestead from higher ground. If you can hit this water with your well the water may gush or flow freely from the well without any pump.

If you do not hit an artesian well vein you will need a water pump and you can use any of the pumping methods suggested for the sand point system in this chapter.

My powered well drilling experience

I helped a friend drill a 150 foot well using a RockMaster 4500 he rented. The equipment was very sturdy and straightforward in its use. We set it up on level ground, dug a couple of small catch pits for water runoff, poured in some fresh water and drill mud, attached the drill bit and started the motor. We drilled about 2 feet in 10 minutes and only hit two rocks in 150 feet which slowed us down a little.

Other than attaching new lengths of pipe and refilling the trench there isn't much to do. We sat in lawn chairs drinking beer and watching the drill do its work. All together the well was drilled, sealed and pumping clean water in less than 8 hours.

We are lucky to live near mountains with lots of ground water so we hit a good artesian water vein and my friends well started gushing a good flow at 150 feet. He attached his well to an overflow tank and uses a 12 volt pump to pump it to his house.

Supplies:

[Sandpoint well tip $40]

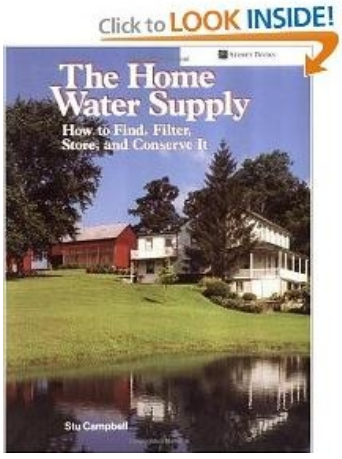
[Pipe drive coupler $8]

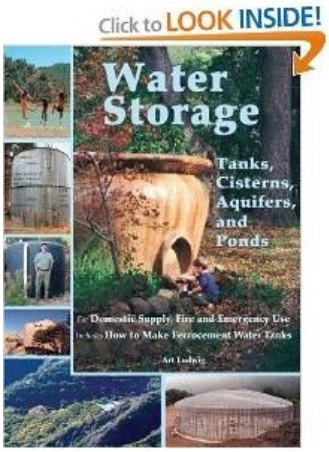
[Sandpoint drive cap $12]

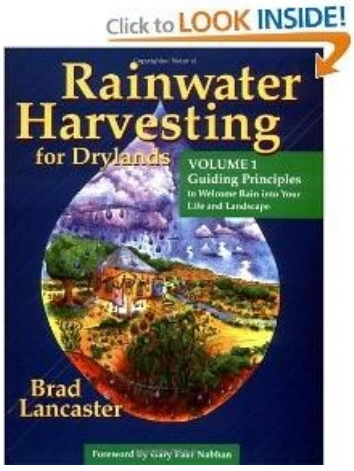
[Pitcher pump $40]

[Shallow well Jet Pump]

[Water pressure tank]







Preparing for possible economic collapse (water from a **sand point well**)

Basic info on how to install a **sand point well** for emergency water use.

by houndsman03 | 2 months ago | **2,049 views**

Cabin Septic systems

If you will be using the cabin for vacationing you can probably get by with a porta-potty that can be emptied into a conventional toilet or RV septic dump station.

For a permanent toilet you have the option of a conventional flush toilet and septic tank system, a commercial composting toilet, or a homemade composting toilet.

It is beyond the scope of this book to cover conventional septic systems but here is a great PDF that describes the building process:

http://www.nmenv.state.nm.us/fod/liquidwaste/homeowner%20notebook%20final%202006.pdf

Commercial composting toilets have been around for many years and have proven themselves to work well under certain conditions. The microbes that digest waste and turn it into compost work best when kept warm and unless your cabin is heated or you live in a year round warm climate in the winter a commercial composting toilet is not the best choice.

If you can keep the commercial composting toilet warm there are a few models to choose from:

Natures Head Dry Composting Toilet

Biolet non-electric waterless

Click on image for more information

I recommend getting the optional solar powered vent fan for these and you will need to install a vent pipe through the cabin wall or roof. For occasional use in a vacation cabin or in a heated cabin these commercial composting toilets will do the job but they are a bit expensive.

Sawdust Composting Toilet

For many hundreds of years Homesteaders used outhouses and you can still find these in remote areas and other countries.

Because of the possibility of contaminating groundwater outhouses are no longer allowed in most areas unless they are self contained with a holding tank that can be pumped to a waste station.

If you are interested in using a commercial outhouse there are places that rent them and usually include a dumping service. These may be useful as a temporary toilet while you are building your home but because they are outside and unheated most people would not be comfortable using them for a year round permanent toilet.

Another option that many homesteaders use is a sawdust toilet and an outside composting pile or bin. This gives the convenience of having a toilet in the house and does not require any plumbing.

Not all areas allow sawdust toilets but in rural areas with no septic requirements these may be used. As always check your county codes.

Sawdust toilets are basically a 5 gallon bucket with a seat to hold the waste and after each use it is sprinkled with sawdust to absorb the moisture and reduce any smell. Biodegradable toilet tissue can be put in the bucket but no antibacterial cleaners should be used inside the bucket or you will kill the microbes that digest the waste.

When the bucket is full it is taken outside to a compost pit or bin and dumped. Human waste also called humanure is about 90% water and 10% fecal matter. The humanure is digested by microbes that are already present in the waste and the small amount of stuff left over from the microbes is called compost.

Microbes work best in temperatures above 50 degrees and are most active in temperatures above 70 degrees. If the temperature drops below 50 microbes hibernate and can freeze and die in lower temperatures. I will show you a cheap simple way to use the sun to keep the microbes warmer and speed up the compost process later in this chapter.

Is Human Waste Compost Safe ?

Generally speaking, human waste is safe if the people using the toilet are healthy. For this reason I do not recommend letting strangers or anyone with a communicable disease use your composting toilet.

The microbes will eat and compost the waste and the temperature in the compost will generally kill any bad microbes or diseases that may be present. Humanure waste can be used around shrubs, flowers and fruit trees but is not recommended for vegetable gardens.

Always wear a mask and gloves when turning the compost bin or using the humanure as fertilizer!

The toilet

You need a 5 gallon bucket, a toilet seat, and a wood box to enclose the bucket

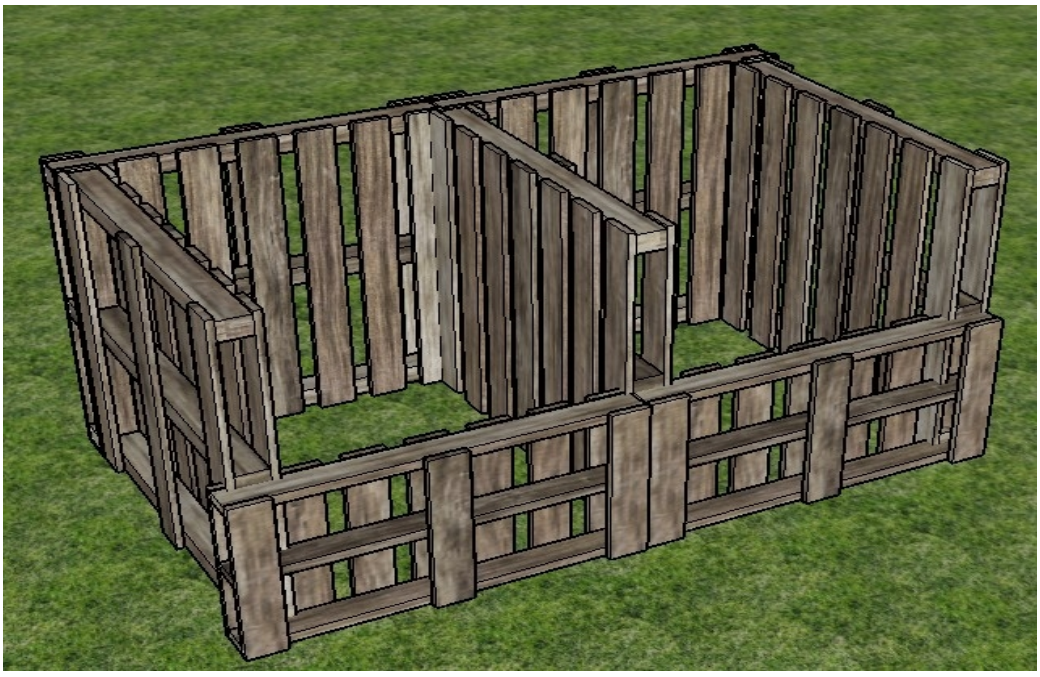
You can salvage these or buy them new at any home supply store. The box can be made out of any wood and plywood can be stained or painted to fit your decor.

You can buy bags of sawdust at most home or garden supply stores or visit your local sawmill and get a pickup load for almost nothing. You can also use pine needles, peat moss, grass, clippings, shredded paper, or straw.

The compost pit

The compost pit can be as simple as a shallow pit lined with a layer of straw or a cement block or pallet bin. The bins will provide some security from pests and kids getting in to the compost and I recommend a bin composting pit.

The easiest to build is a double bin composter using recycled pallets:



How it works

Dig two shallow pits and construct the compost bins around these pits using pallets or salvaged cement blocks.

Put a layer of old straw, leaves or grass clippings into the pit as a compost starter and to absorb any excess moisture.

When your toilet is full empty it into one of the bins and cover with a thin layer of straw, leaves, or grass clippings.

Using a shovel or rake make a depression in the middle of the pile and pour in the toilet contents. Cover the waste by Moving the outside edges of the compost pile to the middle so it is covered.

The microbes will quickly go to work digesting the humanure and the sawdust, straw and grass clippings turning into a rich compost that can be used as fertilizer around shrubs, flowers, and fruit trees.

When the first bin is full cover that side with clear plastic and let it sit for at least a year before using the compost. Switch to the second bin and start the process all over again.

The two bin unit will handle a family of 4 and for larger families a 3 or 4 bin unit is recommended.

For more info on Humanure composting visit: http://www.jenkinspublishing.com/sawdustoilet.html

The Solar Composting Toilet

I designed the solar composting toilet to speed up the process of composting by keeping the microbes warmer and to eliminate the need for sawdust or any added materials.

Instead of a sawdust bucket toilet I use a commercial porta-potty that has a 5 gallon holding tank and the solar composter evaporates the excess moisture away so there is almost nothing left in the composter after just a few days. It does not require any turning or emptying.

For this project you will need to dig a 4 foot by 8 foot pit that is 4 feet deep and line it with cement block. The cement blocks can be dry laid and pinned in place with rebar.

The composter box is made from plywood or wafer board and 2x4s and should cover the cement block pit completely.

The back of the box should be higher than the front and the dimensions I used are 1 ½ feet for the back, 1 foot for the front and the sides are 4 feet by 8 feet. The angle of the top will allow more sunshine to penetrate the box in the winter when the sun is lower in the sky.

Paint the outside of the box to prevent weathering.

I used a 3 inch Dia. PVC elbow with a matching cap for the waste inlet:

The Solar Composting box is covered with two layers of clear plastic. I do not recommend glass if there is any chance a child or animal may climb on the box.

Here I am emptying the porta potty into the solar composter. I empty my toilet twice a week on average with two people using it.

How to build
a solar composting toilet
for under $50

Typical composting toilets fail for two reasons, too cold and too wet. I have designed a solar assisted composting toilet that reduces these problems and speeds up composting by 2/3 the usual time.

NOTICE: I am not an engineer and these plans are experimental and probably do not meet health codes so build and use at your own risk!

Cost: You can buy two sheets of wafer board, (4) 2 x 4s, a roll of clear plastic , a roll of black plastic, and a 3 foot piece of black 3 inch pvc pipe for about $30 or you can scrounge around any construction dumpster or garbage dump and find most of your material for free!

Time: I built the composter and dug two small pits in about 3 hours

Skill: If you can cut a straight line, hammer a nail and dig a hole you can build this composter

How it works:

A composting toilet is simple unit designed to let natural micro-organisms do their job in breaking down waste into a substance called compost. These micro-organisms occur naturally in all good soil, Human feces and urine is not much different than animal feces and urine which has been used for decades to raise nitrogen levels on farmland and increase crop growth.

The composter is actually two components. The first is the waste receptacle or toilet which can be as simple as a 5 gallon bucket with a toilet seat or as beautifully designed as your imagination provides. What matters is only that it can be easily carried and is large enough to hold enough waste so emptying is done about once a week. A 5 gallon bucket with a sturdy handle will take care of a 3 person family for that need. I suggest building two of these so you can swap the empty for the full one when emptying. If you don't want to build one you can purchase a porta-potty or camp toilet at any sporting goods store.

The second component of the solar composting toilet is a pit lined with plastic to hold the waste and keep it from seeping into the ground and a box that can collect and hold the suns heat inside. The reason for the solar box is to increase the temperature of the waste so the micro-organisms which are only active above 50 degrees can do their job more effectively. Most store bought composting toilets either require an indoor storage tank or a heater to keep micro-organisms from going dormant in cool temperatures. With a solar composting toilet you wont need electricity to heat the unit or a tank inside your home to hold compost. About 90% of human waste is urine which is sterile water and when you eliminate this through evaporation there is very little solid waste left to break down by the micro-organisms. The solar composting toilet will raise the temperature of the waste and this quickens the evaporation of the moisture leaving only a small amount of solid waste that the micro-organisms can quickly consume and turn into safe odorless fluffy compost that can safely be used as fertilizer around fruit trees and flowers. The secure compost box also provides protection from flies and animals getting into compost and causing a mess.

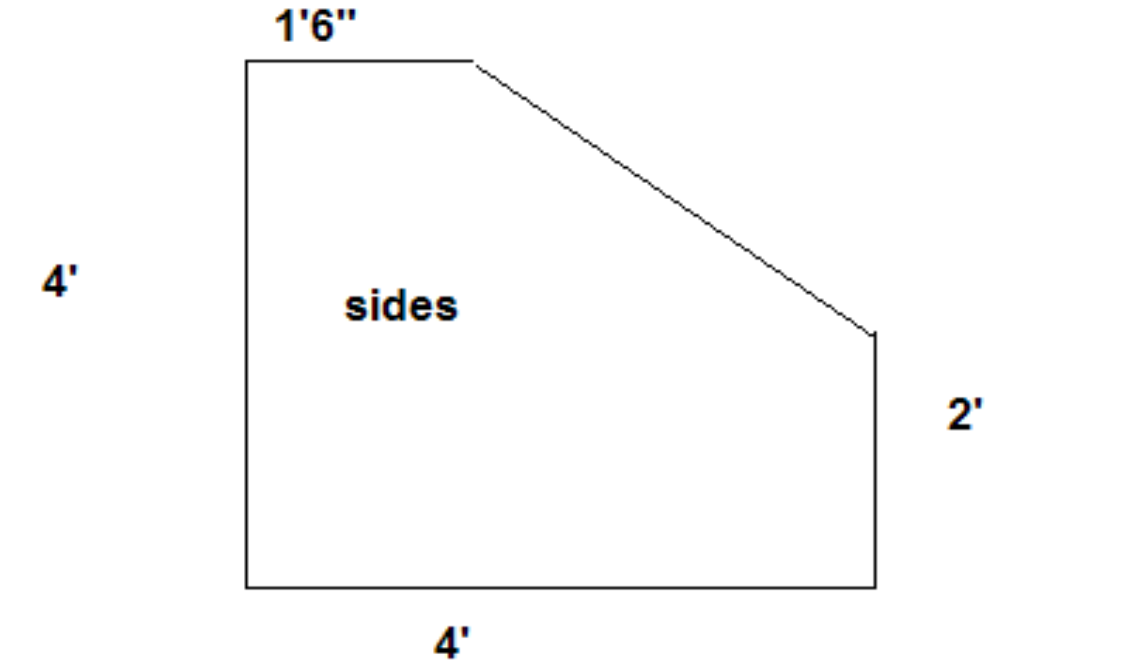
How safe is human manure ?

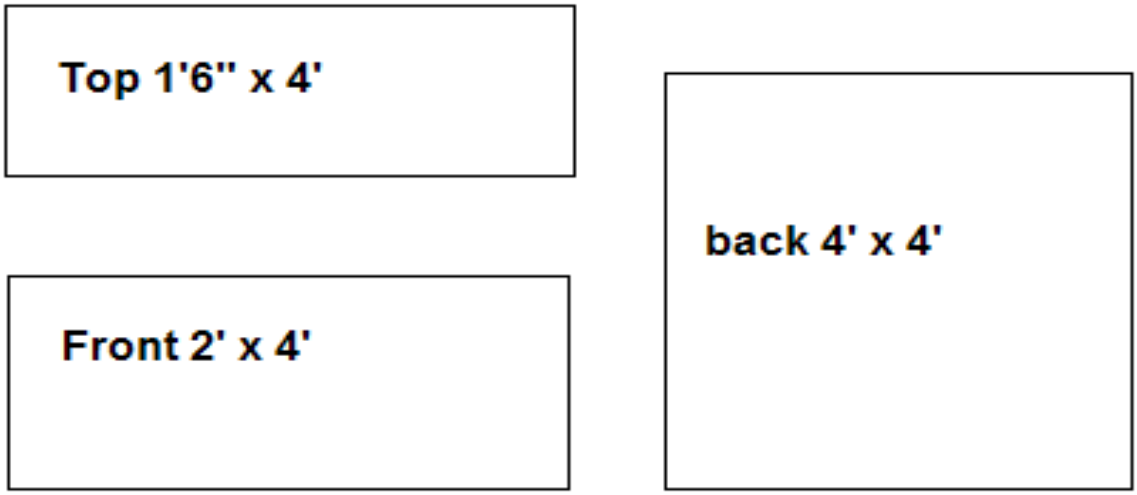
There is some debate over the safety of using human manure on plants that will be eaten. Generally speaking if you and your family are healthy and have no communicable diseases then your waste will be safe for use on non-vegetable plants, but if strangers will be using your toilet you should take precautions to not use waste that could be contaminated with disease. I always recommend wearing a mask, gloves and eye protection when stirring the compost pit or handling human manure, and to be safe, only use human compost on non-edible plants and not on your vegetable garden. I also recommend having two pits and allowing the waste in a full pit to sit undisturbed and covered by clear plastic for 1 year before using the compost as this gives the micro-organisms time to completely break down the waste.

Step #1: You will need a portable toilet such as the ones sold at sporting goods stores. A porta potty works well and that's what I use or you can build your own out of a 5 gallon bucket and a toilet seat. You will be dumping this into your composter probably twice a week so get something you can handle and carry comfortably. Some people use sawdust or sphagnum moss sprinkled on their toilets to absorb moisture and reduce odors and this is fine to use and won't effect the composter in these plans but DO NOT use cleaning products or dump anything into your toilet that might kill the micro-organisms necessary for the composter to work.

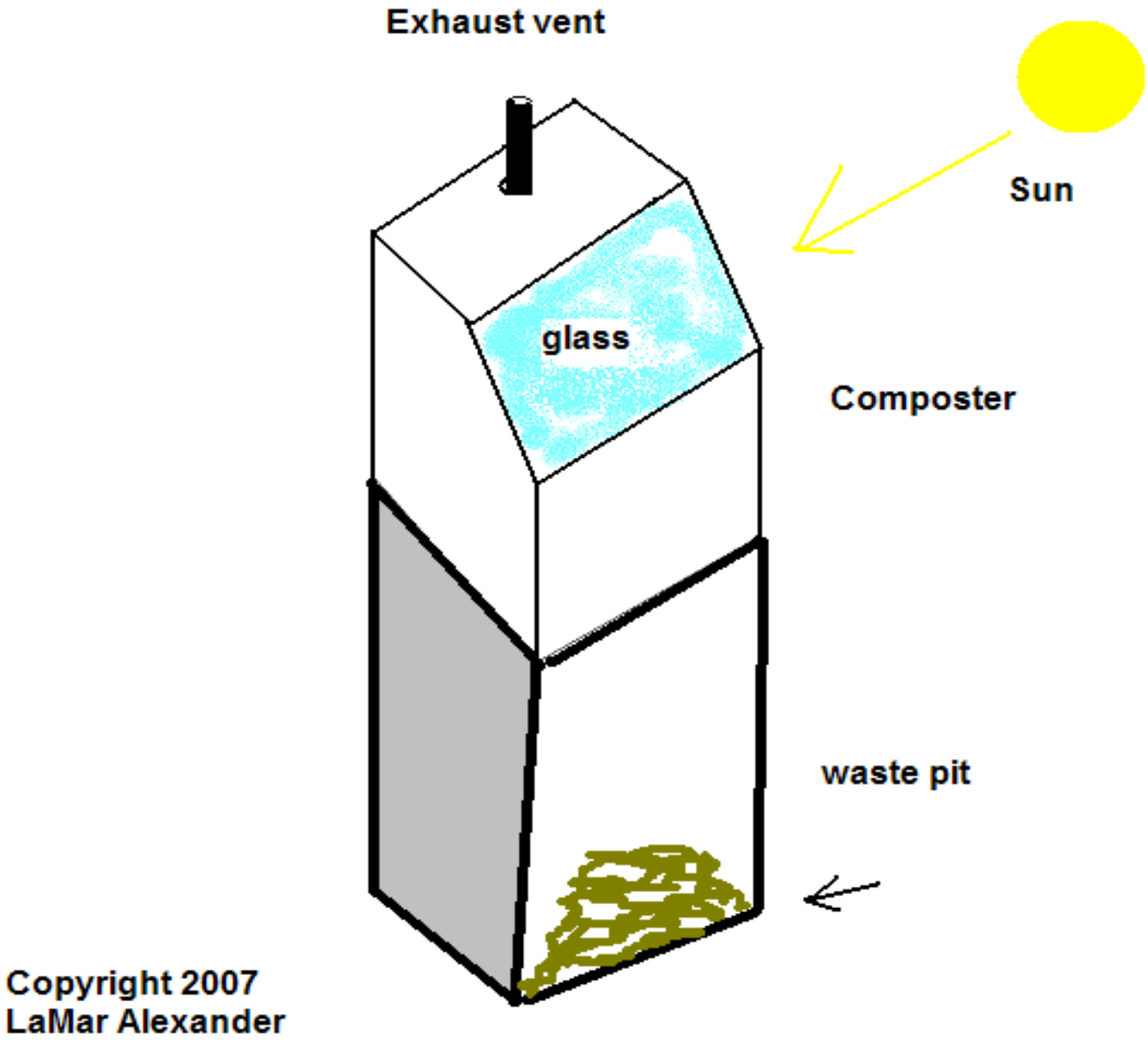
This is a typical porta-potty like I use. The holding tank detaches for easy emptying.
Step #2: Dig 2 compost pits
You will need pits about 3 feet by 3 feet by 3 feet deep. Line them with cement block or brick and line that with several layers of black plastic sheeting. I suggest you build in an area that won't flood , a safe distance from the house, and below your water well. Don't put it where animals or people are likely to fall in!

Step #3: Build your solar composter
You will need two sheets of 4x8 plywood cut to these dimensions. Attach the walls together using 2x4s and deck screws. Make your window out of single or double pane glass or just use a couple layers of clear plastic stapled to the box as I did. Cut a round hole in the top and run a 3 foot piece of black pvc pipe up for a vent. Yes it has to be black as this absorbs heat from the sun and warm air rises making the chimney pull air through quickly. This vent pipe is where the excess moisture will evaporate and also reduces any smell that might come from the composting material.





Step #4: Insulate the composter with foam sheets (you can get used ones in packing crates) as this will help hold the heat in in winter. Place the composter over your compost pit and face the window into the south sun.



Sep # 5: Add compost
Just tip the composter onto its back and dump in your toilet waste.
Put in a little sawdust and a couple handfuls of soil to start the action. Then tip the composter back over the pit and leave it alone. In the day time the sun will heat that composter up to high temperatures and the water will evaporate from the waste material. The bacteria and micro-organisms will break down the solids and within a few days you will have a small amount of nice clean smelling fluffy compost left in the pit. Keep adding waste as you create it.

Step #6: When your pit is about 1/2 full of compost stop emptying waste into the pit for a week and let the micro-organisms finish composting. You can stir the compost easily with a clam digger or shovel to get the top waste into the pile deeper. Use your second pit for waste disposal and put your composter over the second pit. Keep the first pit covered with some clear plastic and place rocks around the edges or cover it with an old wood pallet and clear plastic until it is ready to be used. This compost can be used around fruit trees or other non-vegetable plants. Always wear gloves and wash thoroughly when handling any compost material.

Tips: Try to minimize water in waste and do not put any cleaning products in the pit as it will kill the bacteria. You can add kitchen waste but do not put in meat scraps or things hard to break down. In the winter surround composter with straw bales and throw an insulating blanket over it at night or on super cold sunless days to preserve heat. You may still get some freezing on very cold days but the solar composter will heat back up on sunny winter days and the micro-organisms will go right back to work creating compost. It beats the heck out of an outhouse!

Tip: some toilet papers are so full of perfumes and binders that they do not decompose well. Try to get toilet paper that is environmentally friendly. Usually the cheaper toilet papers are better because they decompose faster.

Cleaning products for your toilet are expensive and they are anti- bacterial which means they kill the good bacteria necessary for decomposing waste. If you want to control odor in a composting toilet sprinkle a little sawdust, pine shavings, peat moss, or dried leaves every time it is used.

Sanitary napkins etc. should not be disposed of in a composting toilet. Avoid putting in anything that will not be composted quickly or may kill bacteria or create a health issue.

Summary:

If you are only using the Cabin for vacation or short stays a porta-potty that can be emptied at an RV station or into any public toilet will work fine. Commercial composting toilets work well in warmer climates but generally you will still need a septic tank system for waste water.

Codes for septic systems vary by state so do your research before designing a system.

If your codes allow for ALTERNATIVE systems the home made composting and solar composting toilets may be allowed for use.

I have used my simple solar composting toilet for over 7 years with absolutely no problems and it has no smell and does not require an expensive tank and drain field. It does require emptying the porta-potty a couple times a week or more often for larger families.

The Humanure composting toilet system is used by many people and here is a video that explains the process:

http://www.youtube.com/watch?v=VcBvarde17s

If you are interested in installing your own septic tank and drain field these videos will help:

http://www.youtube.com/watch?v=3b6oRyfgiAs

NOTICE: the videos and info in this book are for ideas only and it is up to you to research and follow the codes approved for your area!

How to install a wood stove

If you have trees on your property or access to firewood a woodstove is a great addition to your cabin. I have had woodstoves in two homes and love the warmth and even the process of cutting and hauling wood but because wood is scarce and expensive here I have chose to forego a woodstove in my solar cabin. I do keep my old woodstove in storage and could install it in short time if needed. Because I have no personal experience with pellet stoves I have not included them in this section

My woodstove is the cast iron Vogelzang model pictured here:

There are hundreds of styles of wood stove and each maker will tell you there stove is the best but there are a few things to look for in a good wood stove.

1. Does the stove meet US wood stove safety standards. There should be a tag somewhere on the stove stating it has passed safety standards.

2. Will the stove heat the square feet of your home. This heat output will be included in a good stoves instructions. Don't rely on the salesman's opinion.

3. Can the stove be installed in an existing chimney or require special chimney design.

4. Does the stove have a fireproof gasket around the door seal. Doors that leak will not burn as well, create more smoke and carbon monoxide. Check the seal carefully.

5. Does the stove have a flue damper or other control device. The flue damper is necessary to adjust the air draw of the stove. Without one the stove will not work efficiently and could be dangerous in a chimney fire situation.

6. Does the stove need and include firebrick or a grate. Stoves with firebrick will hold heat longer but some newer stoves use a raised grate to increase air to fire which also works. Stoves without a grate or firebrick are prone to burn out the bottom of stove.

7. What material is the stove made out of. Cast Iron holds heat but is brittle and breaks easily. Steel is strong but not as heat resistant or pretty to look at. Soapstone is great at holding heat but is brittle and breaks easily.

8. Can the stove be used in your home. All wood stove manufacturers have strict guidelines for how and where there stove can be used and clearances for their stoves. You MUST follow these guidelines or risk a fire and home insurance problems.

NOTE: before considering a woodstove you should check with your home owner insurance to see if a woodstove is allowed and how it will effect your premium.

All woodstoves have inherent risks and you MUST follow all manufacturer safety and installation guidelines.

Woodstoves are a common cause of home fires, injury and death!

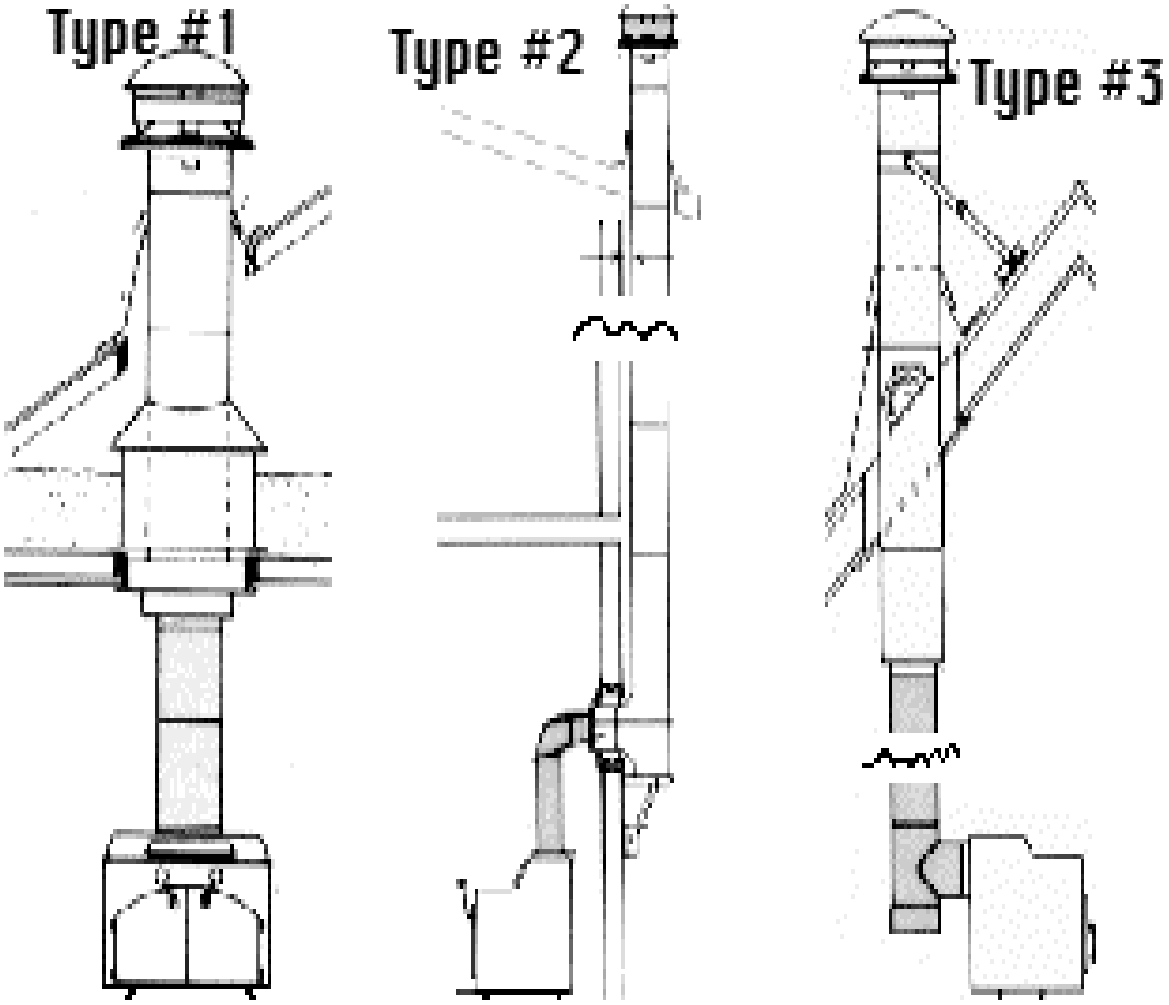
It is beyond the scope of this book to discuss masonry chimneys. If you want to learn about constructing or using an existing masonry chimney consult a wood stove professional.

Legal Disclaimer - This document is not designed to replace your owners manual. It is written to provide an overview of safe installation practice. Consult your hearth professional, building officials and owners manual for the specific installation needs of your appliance. Your dealer or local building official is the best source for additional information. You can also find a list of installers certified by The National Fireplace Institute: (http://www.nficertified.org/pages_consumers/consumers-1.html)

The Chimney

OK, we're going to talk a little about how to properly install a woodstove. The first thing we have to do is to forget about the woodstove and concentrate on the most important part of an installation - the chimney!

RULE #1 - Every Woodstove Must Have a Chimney
This means either a sound masonry chimney (not covered in this book) or a UL approved Stainless Steel Class "A" Insulated Chimney. No - you cannot use stovepipe through the window or roof!



Double & Triple Wall Insulated Class "A" Chimneys
Now that we have that out of the way, let's look at the most popular option for new installations, the Class "A" Insulated Chimney. The diagram above shows the three most common installation types.

Type #1 would be common in any single story construction. Regular black stove pipe is run upwards from the stove and connects with the Insulated Chimney at a special support box located immediately below the ceiling level. Insulated chimney is then stacked up until the required height is obtained. All chimneys must extend a
minimum of 3 feet above the roof surface and 2 feet higher than any part of the building within 10 feet.

Type #2 shows an "out and up" chimney, which exits thru a wall and continues up along the side of the home. If desired, this chimney could be boxed in with wood framing and stuccoed or sided to match the home.

Type #3 is similar to type #1 in that it is a single story installation, but different components are needed due to the slanted ceiling. In this case, the pipe is supported by a bracket at the roof level, and Insulated Chimney Pipe hangs down partially into the room to connect to the interior black stovepipe.

Things to remember
*** No Stovepipe can pass through Walls, Ceilings, Floors or Windows--Use only UL Approved Chimney**

*** Generally speaking, the taller the chimney, the better**

*** The fewest bends = the best draft (chimney suction)**

*** Chimney Should extend 2 feet above anything within 10 Feet or 3 feet above peak**

*** Use a cap which prevents birds from entering**

*** Consult with your Hearth Dealer, Chimney Sweep and Building Official**

<u>The Stovepipe</u>

Stovepipe is used to make a connection from a free standing stove to it's metal or masonry chimney. As previously mentioned, it is not to be used for passing through Walls, Floors or Ceilings. There are two kinds of Stovepipe, Single Wall (one layer) and Close Clearance (two walls). Here's the lowdown on Stovepipe:

<u>Single Wall Stovepipe</u>

Single wall stovepipe is designed to connect a woodstove to a nearby chimney. It is available in different thicknesses (24 ga. or 22 ga.) and is usually painted with a high temperature black paint. Some manufacturers produce stovepipe in porcelain enamel colors to match their stoves. As a general rule (check your label and instructions), stovepipe must be kept at least 18" from any combustible wall, ceiling or furniture. This distance can be reduced in two different ways:

*** Protect the combustible surface with an approved method (see Walls and Floors below)**

*** Install a Stovepipe Heat Shield on the Stovepipe (available through your Hearth Dealer)**
The reductions gained by these methods is usually 50% (9 inches). Stovepipe can usually be trimmed to size with a tin shears or other cutting or grinding tool.
Heavier gauge pipe can be more difficult to cut, so these pipes use adjustable slip joints, which eliminate the need for trimming. When assembling your stovepipe, use black furnace cement to seal between each piece. In addition, use three sheet metal screws at each joint in the pipe. Attach the pipe securely to the stove and chimney, assuring that it is rigid and tight.

Close - Clearance Stovepipe

This is a double wall stovepipe with a stainless steel inner wall and a black painted outer wall. An air space in between the stovepipe walls serves as an insulating layer, allowing this special pipe to be as close as 6" to combustibles. Do not confuse this double-wall interior piping with the Class A Chimney described in the beginning of this document-- this stuff is for interior use only !

Floor and Wall Protection

Underneath your Stove

There are a number of approved materials for underneath a woodstove. Some of them are:

*** Concrete slab, bare or with any tile or brick installed above it**

*** Pre-Fab UL Approved Stove Boards and Mats**

*** Ceramic Tile, Marble or Slate installed on top of UL Listed cement underlayment board (dura-rock and wonderboard are two brand names.**

Different stoves have different requirements, but all woodstoves need to have a non-combustible base underneath. This base should extend a minimum of 8 inches around all sides of the stove and 18 inches in front of any loading doors. In addition, the stoveboard should extend underneath and horizontal run of the stovepipe connection to the chimney.

On the Walls

All stoves must be installed a safe distance from combustible walls. This distance varies depending on the stove model, from as little as 8" to as much as 36" or more. This distance can be reduced by one or both of the following methods:

*** Install approved non-combustible protection on the wall.**
The wall can be brick, stone, cement board or a UL approved stove shield, usually mounted on spacers with a 1" air space to the combustible wall. Check your owners manual or local building codes to determine the size of the wall protection needed.

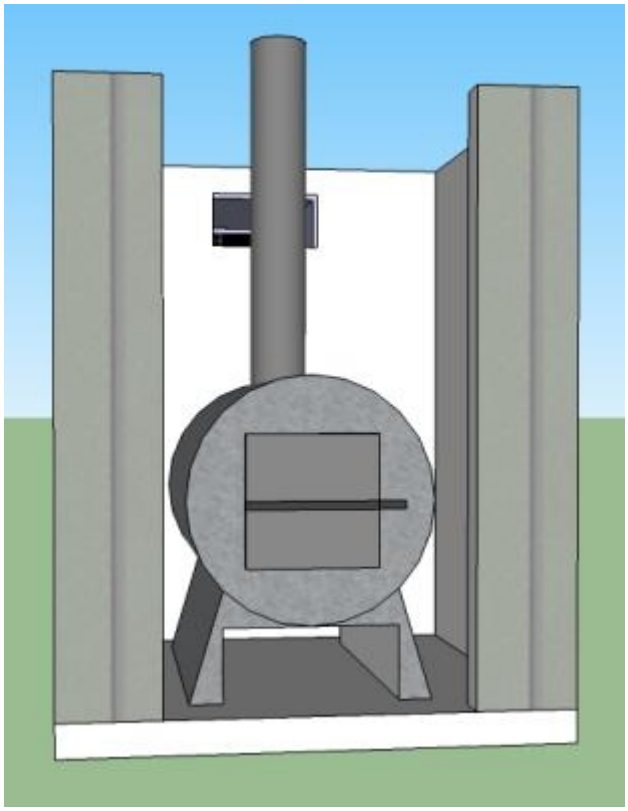
*** Install a specially designed rear heat shield on the stove.**
Check with your Hearth Retailer to see if a rear heat shield is available for the stove of your choice.

NOTE: Before installing any heating device install fire and smoke alarms in all rooms. I also recommend carbon monoxide detectors, a fire extinguisher and fire escape plan.

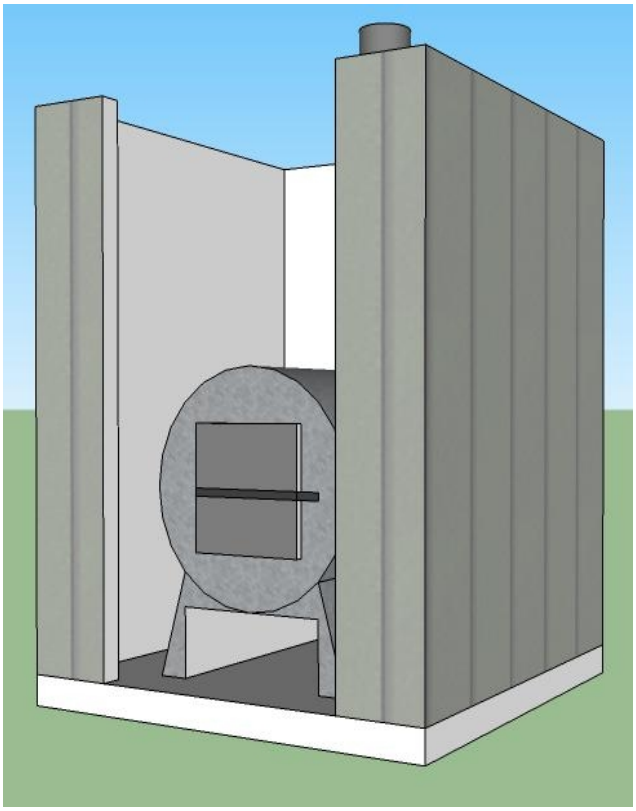
How to build an outside wood furnace and water heater

I love wood stoves but because of my asthma I did not want a wood stove in the cabin so I designed this simple and inexpensive outside wood furnace that is attached to the cabin and can also be used for heating water. Because it is outside it can also be used in summer when you want hot water but not a hot cabin.

This outside wood furnace can also be used for drying fruit, vegetables and meat by simply adding metal rack shelves to the inside walls.



The foundation is 5'x5' with a 4 inch poured cement slab or cement block could be used



Walls are 6' high, 5 feet wide and constructed from metal studs and metal siding

The wood stove is a 55 gallon steel barrel and barrel stove kit available from amazon

These Vogelzang barrel heater kits have been around for a long time and are the easiest way to convert a 35 or 55 gallon barrel to a great wood stove that can also be used to heat your cabin.

Use a layer of good dry sand or fire brick in the bottom of the stove to prevent a burnout. These take an 8" flue.

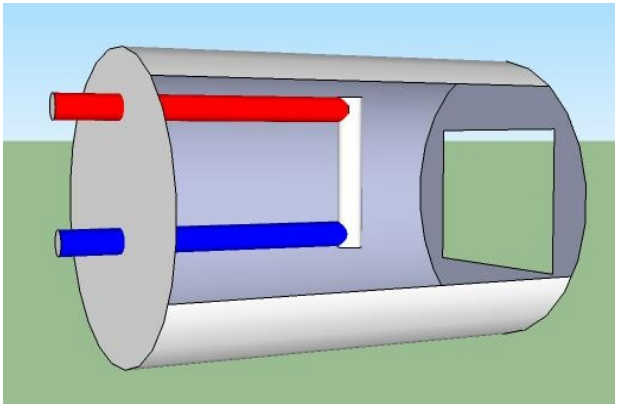
Directions are included with the kit:

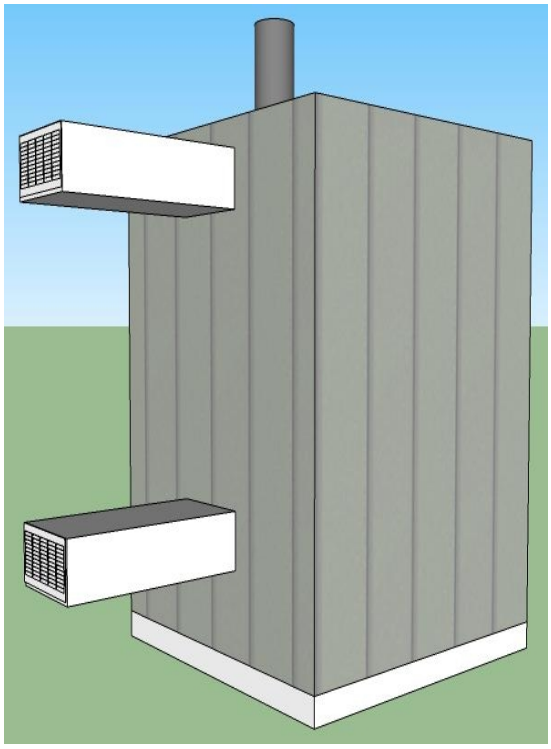
Order from Amazon

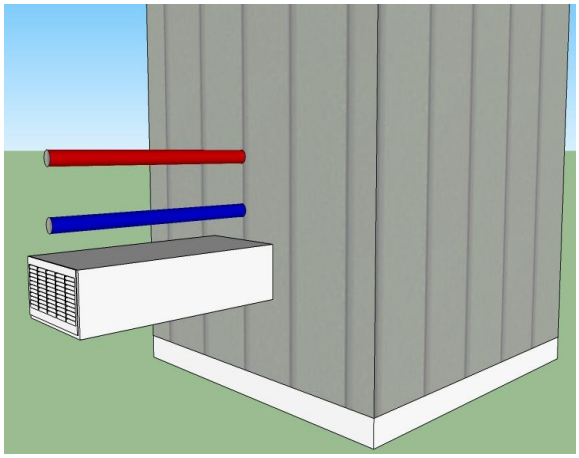
To make the water heater all you need is some lengths of 1 inch steel or copper pipe, two pipe elbows, and stove cement .

Pipe lengths will depend on size of your stove. Seal around pipes to stove with stove cement.

When water heats it rises and will pull cool water in and push hot water out as long as the fire is hot.

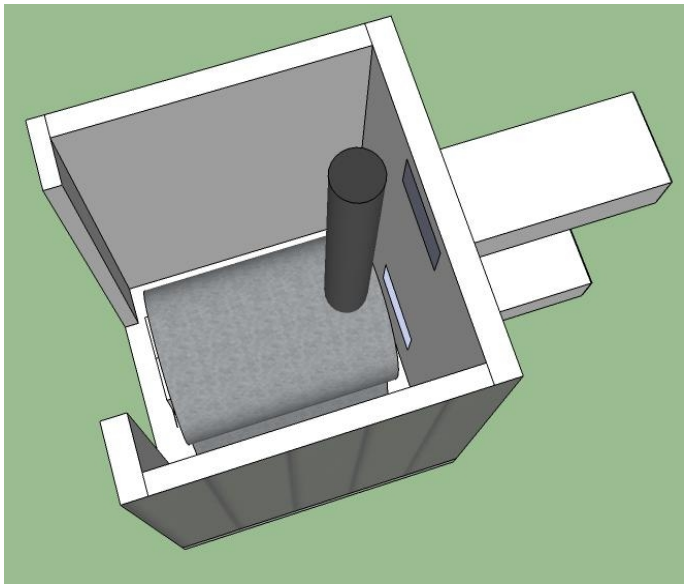






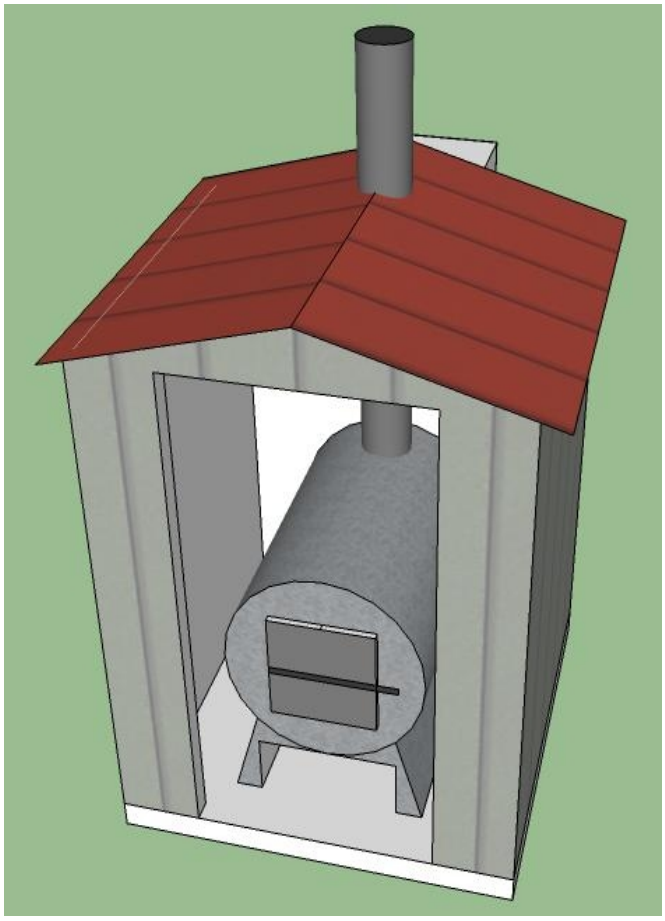
If using this furnace to heat water the pipes will extend through the wall of the furnace to the house and should be insulated.

Two air ducts circulate the air into the house. Cool air is pulled in at floor level and heated air is circulated back into the house. No fan.

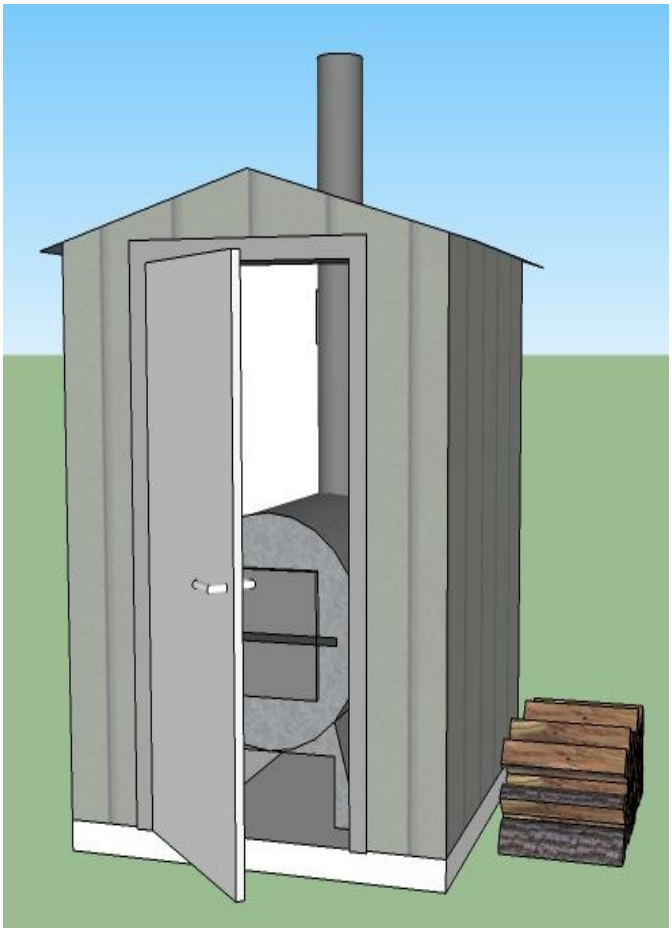


These barrel kits take an 8” flue. Metal ducts and vents are available at most hardware stores.

As the furnace heats up it will pull cold air from the house and heated air rises so the warm air will flow back into the house through the top duct. Vents should be adjustable to close when not in use and to just heat flow.



The roof can be a shed roof or angled roof and is constructed from metal 2x4s and steel roofing



A used steel door finishes the project and install a lock to keep kids out and safe

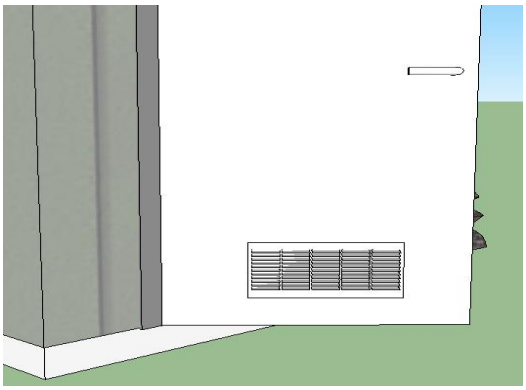
How it works:

Just fill up the wood stove as directed and light your fire. Once the furnace gets hot it will begin pulling cold air from the house through the bottom duct and push warm air into the house through the top duct. No fan is necessary.

These barrel stoves hold a lot of wood so one good loading before bedtime will usually last all night.

If you are using this for water heating it will need to be plumbed into your water tank system and as the water is heated it will circulate through the pipe. This water may get scalding hot!

For summer use you don't want the house heated so install a vent in the door of the furnace to supply fresh outside air for the stove.



A furnace this size will heat a small to medium home with out the ash and smoke released in the house. Follow all safety guidelines for all wood stove use and installation.

Off-Grid Solar Power

Installation and Maintenance Guide

by LaMar Alexander

Off-grid Solar Power Installation and Maintenance Guide: Self help

This book is for anyone thinking about or already living off-grid that wants to learn how to install a solar electric power system and how to maintain the system for optimal performance. Included are step-by-step installation instructions, description of equipment and sources, guides for determining the size of a system needed and detailed illustrations of each component of a system. Also included are simple ways to optimize your solar electric system for best operation, detailed maintenance and repairs for each component and recommended system equipment with links. Plus- how to incorporate wind power into your off-grid system!

In this book you will learn:

1. How solar voltaic panels work to produce energy
2. What each piece of equipment in a solar electric system does
3. What to look for when choosing solar electric equipment and what to avoid
4. how much equipment costs and links to respected dealers
5. How large of a system you will need.
6. How to properly install each component of the system
7. How to trouble shoot, repair and maintain your system
8. What appliances work best with solar power and where to get them
9. How to expand your system for future needs

PLUS- how to add wind power to your off-grid solar electric system

LaMar Alexander is a long time off -grid homesteader who lives year round in the solar cabin he built at the foot of the Uintah Mountains. He is the Author of Simple Solar Homesteading, Owner of Homesteader News, a certified architectural draftsman and off-grid home designer.

He has dedicated his life to helping people to learn how to simplify their lives and preserve old Homesteader ways while incorporating new technology to make life safer and easier!

Off-Grid Solar Power Installation and Maintenance Guide
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ISBN:2120656A- Alexander, LaMar 1964-

FOREWORD

This book is a continuation of my book Simple Solar Homesteading and was written to provide more detailed information for people wanting to design and install their own solar electric and wind power systems.

I have lived off-grid with solar electric power for over 15 years and when I started there was very little information out there about these systems and equipment was in its early infancy.

Times have changed rapidly and now solar electric systems and websites dedicated to solar power are all over the Internet and news. BUT there is still a lack of good information written for the DIY person for designing, installing and maintaining a solar electric system. That is why I wrote this book!

I have tried to simplify everything while maintaining proper use of designs that are used by professional solar installers. The formulas are for basic system design and I have provided links for more complicated design factors.

I am not an engineer or electrician and the information in this book is only for information purposes and should not be used in place of the manufacturers recommendation for equipment installation. I have provided numerous links to other sources of solar design information and those should be used in conjunction with this book.

I have also included many pictures of equipment, appliances, maps, and other sources which when clicked on will take you directly to the website for more information on those products or sources.

Solar and wind power are much more affordable than they were when I started and people can now get a system to handle all their off-grid power needs for $3000-$5000 and even less for small systems under 1kw of power.

One thing we focus very heavily on is how to reduce your energy needs using alternative fuels for large appliances so that your solar electric system does not have to be big and expensive. Conservation of power is the key!

Most people are perfectly capable of installing their own off-grid solar and wind systems but if you feel overwhelmed please contact a licensed solar installer and they can help you design and install a system to fit your needs.

This book is sold only through my website and if you purchased or downloaded a copy from any other source then it is an illegal copy of my copyrighted work. When people steal copies of a copyrighted work it is a federal crime with fines up to $25,000. You are also hurting all writers like me because the small amount of money we make from writing these books goes back into new projects and books to help people like you. Please support the writers that write your books!

You can order a copy or pay for a copy you received directly at my website: www.simplesolarhomesteading.com

Or by snail mail (send $5 cash or money order and email address):

LaMar Alexander
Route 1 Box 1467
Roosevelt, Utah 84066

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NOTICE!

Installing and working with ANY electrical equipment can be dangerous. Follow all manufacturer's recommendations for installation and wear all appropriate safety gear including but not limited to safety glasses, gloves, and work boots.

The author LaMar Alexander will not be responsible for any damages resulting from the use or misuse of information in this book or associated websites. You are responsible for following any manufacturer's recommendations and failure to do so could result in physical injury and death!

If you do not agree to be responsible for your own installation and any harm that results then DO NOT USE THIS BOOK!

What is Off-Grid Living ?

Off-Grid means being disconnected from the grid electricity that feeds through the power lines that service most homes. For some people it also means a simple lifestyle through homesteading and self-sufficiency.

I went off-grid about 15 years ago after I retired from teaching for the state of Utah and going through a divorce. I wanted a change of life from the stress of paying big house payments and utility bills so I could focus on starting a small business, hobbies and spending more time with family.

I wanted a simple inexpensive cabin without utility bills so I designed a small cabin and researched solar and wind power. I determined that solar would work for my needs and wind could be added later.

At present my solar electrical system is 470 watts and is a mixture of different brands of panels I bought over 5 years time, two different brands of deep cycle batteries, an inexpensive MPPT charge controller, and an inexpensive inverter.

That system runs my lights, water pump, TVs, radio, DVD, laptop and miscellaneous gadgets.

I also have a small 125 watt wind turbine that helps to top up the batteries in winter but since we do not get good wind here most of the year I have not installed a larger turbine. We discuss wind turbines in chapter 7.

I use propane for my fridge, stove, furnace, and On Demand water heater so my electricity needs are very low!

Most off-gridders use a combination of solar and wind power for electricity and have a backup generator. They may use wood for heat or propane for other appliances and possibly passive solar air and water heaters to reduce the amount of electricity they need.

The reason for doing this is because solar panels have up to now been very expensive and a smaller system was more affordable for the average person.

Recent changes have pushed solar panels and wind turbine prices much lower and now anyone can afford a solar electric and wind system that wants one. Because of this there are many people choosing to go off-grid with their homes and want more information on how to do it correctly and safely and what to expect from an off-grid system.

That is where this book comes in!

This book is dedicated to off-grid solar and wind systems and will teach you about all the different components of the system, how to choose the right size for your needs, where to get reliable equipment, how to use it, how to get optimal performance from the equipment, and how to repair and maintain the equipment.

We do not include grid tied systems in this book as that is a different method of using solar and wind power in a home that is also tied to existing grid power. The equipment and methodology is different and this book focuses only on off-grid systems.

So if you are interested in off-grid solar and wind electricity lets jump right in!

History of Solar and Wind Electricity

From ancient Greek homes built to face the warm winter sun to advanced thin-film photovoltaics, which generate electricity from the sun, humans have used the sun's rays to meet their energy needs. This makes sense, given that the sun showers the earth every hour with enough energy to meet world demand for a year. And the best part: this energy is pollution-free, inexhaustible and accessible to many.

A Brief History of Solar Energy

Ancient Greeks and Romans saw great benefit in what we now refer to as passive solar design—the use of architecture to make use of the sun's capacity to light and heat indoor spaces. The Greek philosopher Socrates wrote, "In houses that look toward the south, the sun penetrates the portico in winter." Romans advanced the art by covering south facing building openings with glass or mica to hold in the heat of the winter sun. Through calculated use of the sun's energy, Greeks and Romans offset the need to burn wood that was often in short supply.

Auguste Mouchout, inventor of the first active solar motor, questioned the widespread belief that the fossil fuels powering the Industrial Revolution in the 19th century would never run out. "Eventually industry will no longer find in Europe the resources to satisfy its prodigious expansion. Coal will undoubtedly be used up. What will industry do then?" Mouchout asked prophetically.

In 1861, Mouchout developed a steam engine powered entirely by the sun. But its high costs coupled with the falling price of English coal doomed his invention to become a footnote in energy history.

Nevertheless, solar energy continued to intrigue and attract European scientists through the 19th century. Scientists developed large cone-shaped collectors that could boil ammonia to perform work like locomotion and refrigeration. France and England briefly hoped that solar energy could power their growing operations in the sunny colonies of Africa and East Asia.

In the United States, Swedish-born John Ericsson led efforts to harness solar power. He designed the "parabolic trough collector," a technology which functions more than a hundred years later on the same basic design. Ericsson is best known for having conceived the USS Monitor, the armored ship integral to the U.S. Civil War.

Solar power could boast few major gains through the first half of the 20th century, though interest in a solar-powered civilization never completely disappeared. In fact, Albert Einstein was awarded the 1921 Nobel Prize in physics for his research on the photoelectric effect—a phenomenon central to the generation of electricity through solar cells.

Some 50 years prior, William Grylls Adams had discovered that when light was shined upon selenium, the material shed electrons, thereby creating electricity.

In 1953, Bell Laboratories (now AT&T labs) scientists Gerald Pearson, Daryl Chapin and Calvin Fuller developed the first silicon solar cell capable of generating a measurable electric current. The New York Times reported the discovery as "the beginning of a new era, leading eventually to the realization of harnessing the almost limitless energy of the sun for the uses of civilization."

In 1956, solar photovoltaic (PV) cells were far from economically practical. Electricity from solar cells ran about $300 per watt. (For comparison, current market rates for a watt of solar PV hover around $5.) The "Space Race" of the 1950s and 60s gave modest opportunity for progress in solar, as satellites and crafts used solar paneling for electricity.

It was not until October 17, 1973 that solar leapt to prominence in energy research. The Arab Oil Embargo demonstrated the degree to which the Western economy depended upon a cheap and reliable flow of oil. As oil prices nearly doubled over night, leaders became desperate to find a means of reducing this dependence. In addition to increasing automobile fuel economy standards and diversifying energy sources, the U.S. government invested heavily in the solar electric cell that Bell Laboratories had produced with such promise in 1953.

The hope in the 1970s was that through massive investment in subsidies and research, solar photovoltaic costs could drop precipitously and eventually become competitive with fossil fuels.

By the 1990s, the reality was that costs of solar energy had dropped as predicted, but costs of fossil fuels had also dropped—solar was competing with a falling baseline.

However, huge PV market growth in Japan and Germany from the 1990s to the present has re-energized the solar industry. In 2002 Japan installed 25,000 solar rooftops. Such large PV orders are creating economies of scale, thus steadily lowering costs. The PV market is currently growing at a blistering 30 percent per year, with the promise of continually decreasing costs. Meanwhile, solar thermal water heating is an increasingly cost-effective means of lowering gas and electricity demand.

As you've seen, technologies have changed and improved for decades. Still, the basics of solar thermal and photovoltaics have remained the same.- (courtesy of SOUTHFACE)

Solar Power Today

The manufacturing of solar panels for both residential and commercial use is rapidly becoming a huge industry. There are a number of major solar panel manufacturers in the U.S. and a rapidly growing number in Europe. In recent years China has also become a major provider of solar panels both because they have high demand internally and because their low labor costs have helped to bring manufacturing costs down. Listed below are most of the major manufacturers of photovoltaic solar panels which are available in the U.S.: (courtesy ENERGYBIBLE)

Photovoltaic Solar Panel Manufacturers

Advent Solar
Amonix Inc
Atlantis Energy System Inc.
B P Solar Int'l LLC
Canrom Photovoltaics, Inc.
DayStar Technologies Inc.
Energy Photovoltaics Inc,
Evergreen Solar Inc.
First Solar LLC.
GE Energy (USA) LLC
Global Solar Energy Inc.
Innergy Power Corporation,
Iowa Thin Film Technologies
Kyocera Solar Inc.
Matrix Solar Technologies
Mitsubishi Electric & Electronics USA, Inc.
Mitsui Comtek Corp.
Pacific SolarTech
RWE Schott Solar Inc.
SANYO Energy (USA) Corporation
Sanyo Semiconductor Corporation
Sharp Manufacturing Company of America
Shell Solar Industries LP
Solar Power Industries, Inc.
Spire Corporation
Sunpower Corporation
Sunwatt Corporation
Sunwize Technologies LLC
Terra Solar Global, Inc.
Tideland Signal Corporation
United Solar Ovonic LLC.

Off-Grid Solar Homes

Solar panels can be used to provide power to a remote home or to a home in a city using the same technology. Most homes that are completely off-grid use solar and possibly wind power to run all the home appliance electricity the same way you use grid electricity.

Solar panels produce DC or Direct Current that is a steady stream of electricity while grid electricity is AC or Alternating Current and is sent in pulses.

When DC electricity is converted to AC electricity using an Inverter it can be used just the same as grid electricity to run all the appliances in your home and can use your existing home wiring.

Direct Current DC electricity can also be used to run appliances and lights that are designed just for DC current. Your automobile uses DC electricity to run the radio, fans, lights and all the gadgets in a car.

Some off-grid homes use a combination of AC for running standard AC appliances and DC for running special DC appliances in the home.

An off-grid home can be all electric but because it would take a lot of power to run all the large appliances most people have in their homes most off-grid homes use a combination of fuels like propane or natural gas for larger appliances like stoves, furnaces and water heaters and use Solar and wind power for everything else.

Here are some typical off-grid homes:

So we know what it takes to live off grid and how you generate off grid power, but what does living off grid look like? It might be a surprise to some, but some off-grid homes are totally indistinguishable from other houses in the neighborhood (except for the lack of power lines and electricity meters).

Above is the Van Geet Off-Grid Home [pdf], sponsored by the U.S. Department of Energy's Energy Efficiency and Renewable Energy (EERE) Agency. Near Denver, Colorado, the home takes advantage of 300 days of sun to produce lots of its power from a couple of solar arrays, and the home's careful siting makes the most of passive solar and daylighting to minimize the energy needed to run the home. Does it look "off grid" to you?- (TREEHUGGER.COM)

Don Ryan / AP

Off grid living in Oregon
http://www.msnbc.msn.com/id/18744225/
This home, in the Three Rivers community near the central Oregon's Lake Billy Chinook, also uses solar for the bulk of its power needs (as pictured), and one home in the off-grid community went over seven months, from February 11 to September 15 (in 2006) without using their generator; it was all solar.

Nancy Palmieri for USA TODAY

Living off the grid in Vermont
The Doucette family, of Wilmington, Vt., uses a combination of 10 solar panels and an 80-foot tall wind turbine to power their 3,200 square foot plaster-and-tile home; the setup gives them plenty of juice for a home-based business (and the computers, peripherals and lighting required to keep it going), in addition to the rest of their "regular" day-to-day needs.)

Off grid with straw bales in the UK
This straw bale double-wide mobile home, built by Richard and Carol Atkinson of East Yorkshire in the UK, uses solar, wind and solar hot water, in addition to a host of green building materials. And, because straw is plentiful and locally available in the UK, it produced just a fraction of the carbon footprint of an average UK home, 50 tons of carbon dioxide, during construction.

The future of off grid homes in Toronto
There is a confluence of ideas happening that will generate the efficient, green house of the future. Prefab offers the promise of replication of proven, tested designs with factory controlled quality; digital driving of CNC machines offers tighter tolerances, more effective use of materials and less waste. This example is an off-grid cottage, designed by Toronto architect John Bowron, is so energy efficient that "the mice in the kitchen cabinets generate enough heat to keep it warm".

With all of these ideas, the point is simple: you can have any kind of house you want and still live off the grid. Of course, bigger houses need more electricity, so it'll be more expensive, but if bigger is better for you, it can be done. And, if it's good enough for Dilbert, perhaps it's good enough for you, too.- (TREEHUGGER.COM)

My Off-Grid Cabin

My 14x14 Off-grid cabin uses a 470 watt solar and 125 watt wind power system for water pump, lights, TVs, laptop, and misc. gadgets. Propane is used for fridge, stove, furnace, and OD water heater. I live in Utah at the foot of the high Uintah mountains and winters can be very cold. I have been off-grid over 15 years and I love it!

So you can see that off-grid homes come in many sizes, shapes and styles and may look just like any other home with the exception of no ugly power lines running to the house.

Off-grid homes can be very expensive and large or small like mine. Generally speaking the larger the home the more electricity it will need, the more it will cost to heat and cool and the higher the property taxes. Most off-grid homes are medium to small in size for that reason but can be as fancy or simple as you like!

There are some important factors to consider if building or buying an off-grid home like location and orientation that we will cover in chapter 6.

Here are some videos of my cabin and the solar electric system and propane appliances I use:

CHAPTER TWO

How big of a solar electric system do I need ?

To answer that question you need some basic information :

Is your home all electric ?

All electric homes generally consume a lot of power. Electrical appliances like stoves, fridges, furnaces, water heaters ,microwaves, air conditioners and anything with a motor use lots of power.

You can still run an all electric home from an off-grid solar electric system and I know some that do but expect to pay much more for the system.

Will you use alternative fuels for appliances ?

Many off-grid homes use propane or natural gas for their major appliances and these fuels can be used to run a fridge, stove, furnace, water heater and backup power generator.

Propane is a byproduct of natural gas and oil production. It is stored in tanks and fed through hoses or pipes to the appliances.

3 Gallon Propane Tank

100 Gallon Propane Tank

500 Gallon Propane Tank

Propane price depends on your location and availability. Before considering propane contact your local propane delivery service and get a price quote for delivered propane and tank.

Natural gas can also be used to run all those appliances but is not stored on the homeowners property in tanks. It is sent through a city utility line and may not not be available except in or near a town or city.

Contact your city utility department to find out if natural gas is available for your home.

Ceramic Propane Furnace

Natural Gas Water Heater

Dual Fuel Oven

Many people use wood stoves for heat which can be a good option if you have access to inexpensive wood. Pellet stoves and corn stoves are another option.

Blaze King Wood Stove

Pellet Furnace

Outdoor wood furnace

Passive and active solar air and water heaters are also used in many off-grid homes. A passive solar air heater captures the suns rays to heat the air that is then blown or allowed to enter the house to heat it on sunny winter days. Passive and active solar water heaters captures the suns rays to heat water either in a tank or flowing through water lines inside a panel and this hot water can be used for sinks, showers and even to heat the home.

Solar Air Heater

Solar Water Heater

Passive Roof Turbine

Air conditioners use a lot of power but most homes can be cooled naturally with a passive roof turbine, shade trees, proper window overhang, and window coverings like blinds.

If you can reduce your power needs using alternative fuels like propane, natural gas, wood and passive solar heating and cooling the size of your solar electrical system will be much smaller and more affordable!

Determining how much power you use ?

Once you have decided what electrical and alternative fuel appliances you will use in your off-grid home the next step is to determine how much power you will need to operate the home for an average day!

Fist you need to understand some basic math formulas used to determine how much power an appliance consumes.

You will need to know these three terms for power measurement:

Volts indicates the basic unit of power being produced and is similar to how much water pressure you have when you turn on a garden hose.

Amperes or Amps is the current of power produced and is similar to the flow rate (how fast) that water travels through the hose.

Watts is the quantity of power moving through a wire at any given time.

Watts = Volts X Amps Amps = Watts / Volts

To find the watts used by any given appliance look at the attached specification label usually on the back of an appliance. The number given will usually be in Watts. If you can not find the label you can use a Watt Meter to determine exactly how many watts an appliance consumes.

This instrument is called a Kill – A – Watt and you can click on the picture to order one:

Follow the directions on the unit and plug the meter into the outlet and the appliance into the meter and record the watts used for each appliance in your off-grid home.

Write the appliance name, watts used, and average hours the appliance will be used each day as shown here:

Appliance	Watts	Hours a day used
_____	_____	_____

On the next page is a printable worksheet that gives you the average watts used for most appliances to make things simpler. Just plug in your kill a watt numbers into the worksheet or use the supplied numbers for an estimate.

There are blank rows provided on the worksheet for appliances not listed.

APPLIANCE	WATTS	HOURS PER DAY	WATT-HOURS PER DAY
Microwave oven, average size	1260		
Microwave, small, with timer knob	900		
Food blender or processor	200		
Toaster	1200		
Clothes washer, standard	700		
Clothes washer, efficient (Staber)	200		
Vacuum Cleaner	550		
Electric blanket	180		
DC power bed-warmer	60		
Refrigerator/freezer, 15 cuft energy star			1500
Small apartment refrigerator, 4 cu. ft.			1000
12/24 volt RV NovaKool 4 cu. ft. with added insulation			250
10 cuft freezer, standard			1000
10 cuft Crosley Chest Freezer			500
Window air conditioner, smallest	660		
Ceiling fan, AC	60		
Ceiling fan, 12/24 volt DC	5 - 20		
Water well pump, 120 volt AC 100 gal/day	1000		
Water well pump, DC 100 gal/day	100		
Standard 60 watt light (not recommended)	60		
Compact fluorescent bulbs equal to 60 watt incadescent	15		
Computer	100		
HP Lazerjet printer in operation	90		
19" color TV	85		
20" LCD TV	120		
32" LCD TV	140		
50" LCD TV	160		
Satellite receiver	20		
Quality Stereo	40		

Calculating your average daily power use

If you have used the Kill-a watt meter and the worksheet you should now have numbers in the right hand column that can be added together to give you approximately how many watts you use on an average day.

It is recommend you do a worksheet for both summer and winter use:

Add all the numbers in the right hand column together and record the like this:

Average Daily Power Use in Summer: _____

Average Daily Power Use in Winter: _____

Take the bigger of the two numbers (usually winter use) and that is how many watts of power you will need to produce from solar and wind power to run your off-grid home. We use the bigger number because if you have enough power to meet that need you will have enough power to run the home year round. If you will only be using the home seasonally then use only the months you will be actively living in the home.

Don't panic if it seems like a lot because in the next chapter we will show you how to reduce that amount by choosing electrical appliances and alternative fuel appliances to reduce your power needs.

You will notice that we did not include some appliances like electric water heaters, and electric furnaces in the table. That is because those appliances consume so much power that they are not recommended for off-grid living and propane, natural gas, passive solar, and wood can replace those electric appliances and should be used.

After reading the next chapter on reducing your power needs make a new list of the appliances you will use in your off-grid home using alternative energy appliances recommended and recalculate you daily power use. You will probably see a BIG reduction and a BIG savings in the size of system you will need!

As stated earlier you can have an all electric off-grid home and if that is what you want you can use the worksheet and Kill-a-watt meter to determine your power use.

However, all electric homes have some major drawbacks that you need to be aware of:

All electric homes consume a lot of power so your solar electric and wind system will be big and expensive

All electric homes rely on just one power source and if your solar and wind system fails for some reason your furnace, fridge, stove and other appliances will not work.

All electric homes are more prone to major shifts in power use in winter and summer and if the system is not sized correctly you will have trouble meeting your power needs.

The few people I know that have all electric off-grid homes use only Energy Star appliances and very few appliances. They also live in warmer climates where heating is not an issue and rely on passive cooling instead of air conditioners.

If your off-grid home will require heat and hot water then it is recommended you use alternative fuel and passive solar for those appliances and other appliances to reduce the size of solar and wind power system you need.

How do I reduce my power needs ?

Alternative Energy Appliances

Most off-grid homes use alternative fuel appliances and passive and active solar air heat and water heating. There are other types of alternative energy systems out there like small hydro plants for people with rivers running through their property and geothermal heat pumps that can be used but those are not within the scope of this book.

The BIG power pigs!

There are seven main appliances that use most of the power in a home:

The Furnace

If you heat with electricity or use a gas or wood furnace with a blower it consumes a lot of power!

You can choose many different heating methods and appliances that will heat your home just fine without using electricity. Some of these were presented earlier but we will go more in depth here.

Wood stoves without blowers:

If you have access to wood either on your property or cutting wood with a permit then a wood stove can be a great choice. Keep in mind that chainsaws, gas, and a truck to haul it in will add to the expense!

Propane and natural gas furnaces:

These can be used in most off-grid homes but check your local propane company for prices and delivery. Propane requires tanks stored on the property and natural gas may only be available in a city or town. Hooking up a propane or natural gas system can be done by a homeowner with experience but best left to a professional!

Passive solar air heaters:

These are used in conjunction with another heat source listed above. They only work on sunny winter days but can greatly increase the heat in a home while reducing the cost for heat.

Solar porches:

A solar porch or solarium attached to the south side of a house can collect heat on sunny winter days that can be vented through a door or window to greatly increase the heat inside the home while reducing heating costs.

Fireplaces:

Generally not as efficient as a wood stove however soapstone and fireplace insert stoves are more efficient and can use either propane, natural gas, wood, or pellets depending on the model.

Solar water home heating:

This requires a south facing wall or roof and solar water heat collectors. It would be better suited for warm climate use only. Water or an antifreeze solution is heated by the sun and then ran through special pipes under the floor.

Passive solar windows:

When a home is properly oriented the windows on the south side can collect the winter suns rays and warm the interior of the house. Proper overhangs above windows and blinds must be use to keep summer sun from overheating the house and thermal window covers used in winter to keep heat in at night. These would be used in conjunction with another heat source to increase heat in the home and reduce heating costs.

The Water Heater

Electric water heaters keep water warm 24 hours a day just in case you need to wash your hands at 3 AM. They are major power wasters and can be eliminated by any of these appliances:

On Demand Water Heaters:

These have been tested and refined for homes and are now the most used off-grid water heater used. They come in various sizes, fuels, and uses so determine your needs before purchasing.

Passive Solar Water heaters:

These do not use a pump so no power needed. They are also called batch water heaters. They will work year round in warmer climates but used seasonally in colder climates to reduce water heating costs.

Active Solar Water Heaters:

These use a pump to push water or an anti-freeze solution through a roof top collector to heat a tank of water that is inside the house. There are many models and different designs available so do your research before buying!

Wood Stove Water Heaters:

Not as commonly used but if you have access to cheap wood it can be used for water heating.

The Fridge

An electric fridge runs off-and-on 24 hours a day and consumes a lot of power. Energy Star fridges have been designed that use less power but you also have alternative fuel fridges that will eliminate the electricity used. Smaller Dorm room fridges also use less power and would work in an off-grid home.

Propane Fridges and natural gas fridges:

There are many makes and models of propane and natural gas fridges so do your research. These fridges do not use a lot of fuel but do require some regular maintenance to keep them operating correctly.

12 Volt Fridges (coolers): These small cooler fridges use less power than a standard fridge but will still use power. They come in various sizes and prices so do your research before buying. They would be smaller than a conventional fridge but for limited use or in an off-grid cabin used seasonally these would work well!

The ice box: Old homesteaders used ice to keep food cold and there is no reason it can not be used today. Coolers are better designed these days and many will keep ice and food cold for up to 5 days. Cooler efficiency can be increased by building an insulated box around the cooler to keep it cold longer. These are good for limited use and off-grid cabins used seasonally.

The Freezer

Upright freezers use a lot of power because every time you open the door the cold air falls out and the fridge has to kick on to get it cold again. Chest freezers use less power and small chest freezers are the best choice for an off-grid home.

The Washing Machine

Electric washing machines use a lot of power to turn a motor. There are energy star washing machines that use less but still require a bigger solar electric system.

The WonderWasher:

If all you need is a small load of clothes washed these hand crank washers do a great job and would be good for seasonal use off-grid homes.

The Mini-washers:

Designed for small apartments they use less power and will handle smaller loads.

The Generator Washer:

Many off-grid homes use a conventional washer but power it with a generator instead of the solar electric system to keep their system smaller. An average washer can be run off a 4000 watt generator or larger with a 220 volt outlet.

The Clothes Dryer

Electric clothes dryers use a lot of power to heat and turn the clothes. They could be run off a generator the same as a washing machine and the Energy Star dryers use less power.

The Mini-dryers:

Designed for apartment use and can handle small loads. The small extractors also work well to reduce water in clothes before hanging to dry.

The Solar Clothes Dryer:

Just a a simple clothes line placed in the sun will dry your clothes naturally with no electricity. This is the preferred method for most off-grid homes!

The Water Pump

If you have well water a pump may be required but they make solar water pumps that will work for most wells and jet pumps that use less power to operate.

The Solar Water Pump:

These could be tied into your home solar electric system or as a separate unit

The 12 volt Water Pump:

If you will be hauling in water or using a storage tank for water the small 12 volt water pumps will give you excellent pressure and use less power.

The Hand Pump:

Some wells can be operated using a hand pump for no electricity use at all. Do your research to determine if you can use one of these on your well before buying!

The Stove

The electric kitchen stove uses lots of power to heat food and Energy Star stoves are available that use less power but a propane or natural gas stove works equally well (some say better) for cooking and no power required.

The gas stoves:

These come in a wide variety of models and can be inexpensive to very expensive.

The wood cook stoves:

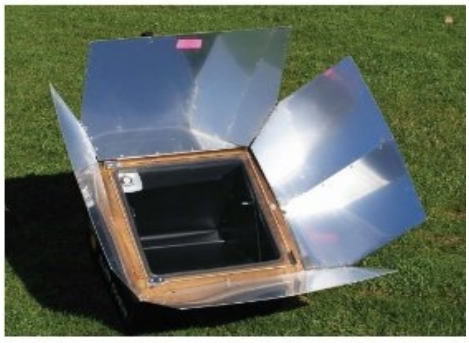
Wood can be used for cooking as many old homesteaders know and wood cook stoves are still available if you have access to cheap wood. These are nice to have as a backup in the event other fuels were not available. They would work fine for limited use and for off-grid seasonal cabins.

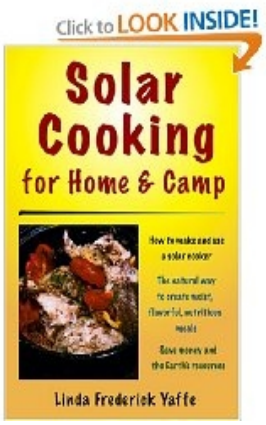
The Microwave

Electric microwaves use a lot of power but smaller units can be run off a generator and Energy Star microwaves use less power.

Most off-grid homes do without a microwave all together but if you need one the smaller units under 700 watts can be used for limited use.

The Solar Ovens





Just threw this in here to show you that the sun can also be used to heat your food. A solar oven is slower than a conventional oven generally but requires no electricity or fuel. Good for limited use and to reduce heat in the home from cooking and reduces fuel bills!

Basic Solar System Sizing

OK, if you have went through the worksheet and decided on appliances that you will use for your off-grid home then you are finally ready to figure out what size system you need!

Write down the average daily power use total you calculated from the worksheet:

AVERAGE DAILY POWER USE: _____

This is the figure we will use for determining the size system you need.

You will want a solar electric system that will provide at least that many watts in one day so that you can power everything plus you want some extra in case you add an appliance or change to appliances with more watts. A general rule of thumb is to have 30% more than you need.

Your solar panels will only produce power in the daytime and only when the sun is shining. In summer the sun may shine for 8 hours or more each day but in winter you may be lucky to get 3 or 4 hours of good sun. To prevent undersizing your system we will size it for winter use. That way you will have enough power in winter and more than enough in summer.

For simplicity sake let's assume your total average daily power use is 1000 watts or 1kw (kilowatt is 1000 watts).

You want 30% more than your actual use so you need 1300 watts or 1.3kw

On the map below find the zone you are in and the average hours of sunshine for that zone.

SUN HOURS/DAY ZONE SOLAR INSOLATION MAP

Zone 1	**6 hours**
Zone 2	**5.5 hours**
Zone 3	**5 hours**
Zone 4	**4.5 hours**
Zone 5	**4.2 hours**
Zone 6	**3.5 hours**

Average hours of sunshine

The average hours is based on 365 day year and can vary as much as 25% to 50% from the stated number of hours.

Winter days get much less sun on average than summer days so reduce your zone average by 1 hour and you will have a pretty good approximation of how many hours of good sunlight you will have on a sunny winter day. It your off-grid home is used seasonally and not in winter you can use the actual zone average.

For example: I live in Utah in zone 3 and average 5 hours of good sun a day yearly. My winter sun drops to about 4 hours daily. So I can only count on 4 hours of good sunshine on an average winter day.

From the example we said you need 1.3kw or 1300 watts to run your appliances for one day so divide 1300 watts by the number of hours you will average of good sunshine in winter.

For example I average 4 hours of good sunshine on winter days so 1300 watts / 4 hours = 325 watts needed per hour.

So my solar panels need to be able to produce 325 watts per hour to meet my needs.

Since solar panels produce less in cold weather and there are days when you may not even get the average sunshine I would adjust that figure to 500 watts just to be sure I have enough power.

So now you can use the examples, worksheet and map above to figure out how big of a system you need:

1)Total watts used daily (from worksheet total) _____

2) Plus 30% for changes (multiply total daily watts by .30) _____

3) Adjusted watts used daily (add total watts used and the 30% together) _____

4) Hours of winter sun shine (from zone map reduced by 1 hour) _____

5) Watts needed (divide adjusted watts by winter sunshine hours) _____

This is the size of solar electric system watts you will need to handle both your winter and summer power uses. You will have more power than you need in summer and enough to run everything you need in winter.

This figure only represents the amount of watts of solar panels you need and does not tell you how much storage capacity in batteries you will need. That will be explained on the next page.

Solar panels come in watts based on 5 watt cells so panels may be 5 watt, 45 watt, 80 watt, 125 watt etc.

I like to round up and add an extra 50-100 watts just to be safe so for example if your total watts is 335 round up to 400 watts. This gives you some breathing room in case your appliances use more than expected (most do).

Now that you know how many watts you will need you may want to go back to the worksheet and recommendations for reducing your power needs and see if you want to make changes to reduce or increase your power use to fit your budget. We will discuss prices and where to get good panels in chapter #

Just a side note: The 500 watt system I described above is my actual system which is 470 watts solar and 125 watts wind power. That powers my water pump, TVs, lights, laptop, DVD, and misc. gadgets through winter and allows me to run more appliances or use appliances longer in summer.

Storage Batteries

Once you have determined how many watts of solar panels you will need you can determine how many and what size storage batteries you need to store that power.

Deep cycle batteries are used for solar and wind power storage. Car batteries are not deep cycle and will not handle the deep draws and charges a deep cycle battery will endure and will fail rapidly.

Marine batteries are not true deep cycle batteries. They can be used but will not last as long or give as good of a performance as true deep cycle batteries.

There are three main types of true deep cycle batteries:

Flooded (wet) cell batteries- These are usually L16 series batteries with an average life span of 4-8 years

Gelled batteries- these have an average lifespan of 2-5 years

AGM (Absorbed Glass Mat) dry cell batteries- these have a average lifespan of 4-7 years

Note: how long a battery will last is determined by the number of cycles it is depleted and recharged, the temperature, the charge rate, and proper care. Batteries that are not drained below 50% and cared for will last longer!

Deep cycle batteries generally come in 6 volt and 12 volt sizes. 6 volt batteries can be connected in series of positive to negative to get 12 volts and 12 volt batteries can be hooked in series positive to negative to get 24 volts.

Since most off-grid homes use a 12 volt system that is what we will focus on in this book.

Storage Capacity

All deep cycle batteries are rated in Amp Hours for storage capacity. An amp-hour is one amp for one hour, or 10 amps for 1/10 of an hour and so forth. It is **amps x hours**. If you have something that pulls 20 amps, and you use it for 20 minutes, then the amp-hours used would be 20 (amps) x .333 (hours), or 6.67 AH. The accepted AH rating time period for batteries used in solar electric and backup power systems (and for nearly all deep cycle batteries) is the "**20 hour rate**". This means that it is discharged down to 10.5 volts over a 20 hour period while the total actual amp-hours it supplies is measured. Sometimes ratings at the **6 hour rate** and **100 hour rate** are also given for comparison and for different applications. The 6-hour rate is often used for industrial batteries, as that is a typical daily duty cycle. Sometimes the 100 hour rate is given just to make the battery look better than it really is, but it is also useful for figuring battery capacity for long-term backup amp-hour requirements.

Basic Battery Storage Sizing

In order to determine battery storage for your system we need to know the Amp hours of your power use so take the average daily watt hours from your worksheet and divide it by 12 (volts) if you will be using a 12 volt system and 24 (volts) if using a 24 volt system.

For example: if your daily average watts use was 2000 then 2000 / 12 = 166.6 Amps

Round up to the nearest tenth to make things easier so call it 170 Amps or Amp hours

Total average daily watts used _____ / 12 = _____ Amps

For 24 volt systems: Total average daily watts used _____ / 24 = _____ Amps

That is your daily average Amp hours used.

So you need a battery storage bank that will allow you to have that many amp hours stored PLUS you want extra storage capacity for days with low sunshine when the solar panels will not fully recharge the system.

A general rule of thumb is to have enough storage capacity to last 3 days with out sunshine in the event you have very cloudy days and that way you can still run your appliances. If you do not get many cloudy days or you get lots of cloudy days in winter you may want to adjust this number up or down. We will use 3 days for this example.

Batteries should not be discharged below 50% of rated amp hours if you want them to last a long time!

If a battery is rated for 225 amp hours at a 20 Amp discharge rate (typical Trojan T105 deep cycle battery) then it is actually a 112.5 amp hour battery at 50% discharge: 225 / 2 = 112.5

So from the example above you would need 2 Trojan T105 batteries with a 225 amp hour rating to handle your daily average amps used.

Since we want 3 days of storage capacity to cover low sun days in winter we multiply our average daily amp hours used by 3 and from the example we used we get: 170 Amps X 3 Day = 510 amp hours

Daily average amps used _____ X days of storage capacity desired _____ = battery amp hours needed

From the example above we need 510 amp hours of storage and a Trojan T105 battery has 112.5 amp hours at 50% so we need 510 / 112.5 = 4.5 batteries.

Since batteries come in standard amp hours we round up to 5 deep cycle Trojan T 105 batteries needed. This formula can be used with any deep cycle battery as long as you know the rated amp hours!

The Sizing formulas given are for a very simplified way to determine a solar electric system that will work for most applications. There are more complex formulas that include other factors but for most off-grid systems the formulas provided will work.

For more detailed information on batteries and battery and panel system sizing use these links:

http://www.solar4power.com/solar-power-sizing.html#battery

http://www.evsolar.com/sizing.html

http://www.countrysidemag.com/issues/93/93-1/sizing_a_solar-electric_system_for_worry-free_off-grid_living.html

What is a Battery? **(This page courtesy of http://www.windsun.com/Batteries/Battery_FAQ.htm)**

A battery, in concept, can be any device that stores energy for later use. A rock, pushed to the top of a hill, can be considered a kind of battery, since the energy used to push it up the hill (chemical energy, from muscles or combustion engines) is converted and stored as potential kinetic energy at the top of the hill. Later, that energy is released as kinetic and thermal energy when the rock rolls down the hill. Not real practical for everyday use though.

Common use of the word, "battery" in electrical terms, is limited to an electrochemical device that converts chemical energy into electricity, by a galvanic cell. A galvanic cell is a fairly simple device consisting of two electrodes of different metals or metal compounds (an anode and a cathode) and an electrolyte (usually acid, but some are alkaline) solution. A "Battery" is two or more of those cells in series, although many types of single cells are usually referred to as batteries - such as flashlight batteries.

As noted above, a battery is an electrical storage device. Batteries do not make electricity, they store it, just as a water tank stores water for future use. As chemicals in the battery change, electrical energy is stored or released. In rechargeable batteries this process can be repeated many times. Batteries are not 100% efficient - some energy is lost as heat and chemical reactions when charging and discharging. If you use 1000 watts from a battery, it might take 1050 or 1250 watts or more to fully recharge it.

Internal Resistance

Part - or most - of the loss in charging and discharging batteries is due to internal resistance. This is converted to heat, which is why batteries get warm when being charged up. The lower the internal resistance, the better.

Slower charging and discharging rates are more efficient. A battery rated at 180 amp-hours over 6 hours might be rated at 220 AH at the 20-hour rate, and 260 AH at the 48-hour rate. Much of this loss of efficiency is due to higher internal resistance at higher amperage rates - internal resistance is not a constant - kind of like "the more you push, the more it pushes back".

Typical efficiency in a lead-acid battery is 85-95%, in alkaline and NiCad battery it is about 65%. True deep cycle AGM's (such as Concorde and Deka) can approach 98%.

Practically all batteries used in PV and all but the smallest backup systems are Lead-Acid type batteries. Even after over a century of use, they still offer the best price to power ratio. A few systems use NiCad, but we do not recommend them except in cases where extremely cold temperatures (-50 F or less) are common. They are expensive to buy, and very expensive to dispose of due the the hazardous nature of Cadmium.

We have had almost no direct experience with the NiFe (alkaline) batteries, but from what we have learned from others we do not not recommend them - one major disadvantage is that there is a large voltage difference between the fully charged and discharged state. Another problem is that they are very inefficient - you lose from 30-40% in heat just in charging and discharging them. Many inverters and charge controls have a hard time with them. It appears that the only current source for new cells seems to be from Hungary.

An important fact is that ALL of the batteries commonly used in deep cycle applications are Lead-Acid. This includes the standard flooded (wet) batteries, gelled, and AGM. They all use the same chemistry, although the actual construction of the plates etc varies.

NiCads, Nickel-Iron, and other types are found in a few systems, but are not common due to their expense, environmental hazards, and/or poor efficiency.

Major Battery Types

Batteries are divided in two ways, by application (what they are used for) and construction (how they are built). The major applications are automotive, marine, and deep-cycle. Deep-cycle includes solar electric (PV), backup power, and RV and boat "house" batteries. The major construction types are flooded (wet), gelled, and AGM (Absorbed Glass Mat). AGM batteries are also sometimes called "starved electrolyte" or "dry", because the fiberglass mat is only 95% saturated with Sulfuric acid and there is no excess liquid.

Flooded may be standard, with removable caps, or the so-called "maintenance free" (that means they are designed to die one week after the warranty runs out). All gelled are sealed and are "valve regulated", which means that a tiny valve keeps a slight positive pressure. Nearly all AGM batteries are sealed valve regulated (commonly referred to as "VRLA" - Valve Regulated Lead-Acid). Most valve regulated are under some pressure - 1 to 4 psi at sea level.

Lifespan of Batteries

The lifespan of a deep cycle battery will vary considerably with how it is used, how it is maintained and charged, temperature, and other factors. In extreme cases, it can vary to extremes - we have seen L-16's killed in less than a year by severe overcharging, and we have a large set of surplus telephone batteries that sees only occasional (5-10 times per year) heavy service that are now over 25 years old. We have seen gelled cells destroyed in one day when overcharged with a large automotive charger. We have seen golf cart batteries destroyed without ever being used in less than a year because they were left sitting in a hot garage without being charged. Even the so-called "dry charged" (where you add acid when you need them) have a shelf life of 18 months at most. They are not totally dry - they are actually filled with acid, the plates formed and charged, then the acid is dumped out.

These are some typical (minimum - maximum) typical expectations for batteries **if used in deep cycle service**. There are so many variables, such as depth of discharge, maintenance, temperature, how often and how deep cycled, etc. that it is almost impossible to give a fixed number.

- Starting: 3-12 months
- Marine: 1-6 years
- Golf cart: 2-7 years
- AGM deep cycle: 4-7 years
- Gelled deep cycle: 2-5 years
- Deep cycle (L-16 type etc): 4-8 years
- Rolls-Surrette premium deep cycle: 7-15 years
- Industrial deep cycle (Crown and Rolls 4KS series): 10-20+ years
- Telephone (float): 2-20 years. These are usually special purpose "float service", but often appear on the surplus market as "deep cycle". They can vary considerably, depending on age, usage, care, and type.
- NiFe (alkaline): 5-35 years
- NiCad: 1-20 years

- # Starting, Marine, and Deep-Cycle Batteries

- **Starting** (sometimes called SLI, for starting, lighting, ignition) batteries are commonly used to start and run engines. Engine starters need a very large starting current for a very short time. Starting batteries have a large number of thin plates for maximum surface area. The plates are composed of a Lead "sponge", similar in appearance to a very fine foam sponge. This gives a very large surface area, but if deep cycled, this sponge will quickly be consumed and fall to the bottom of the cells. Automotive batteries will generally fail after 30-150 deep cycles if deep cycled, while they may last for thousands of cycles in normal starting use (2-5% discharge).
- **Deep cycle** batteries are designed to be discharged down as much as 80% time after time, and have much thicker plates. The major difference between a true deep cycle battery and others is that the plates are SOLID Lead plates - not sponge. This gives less surface area, thus less "instant" power like starting batteries need. *Although these an be cycled down to 20% charge, the best lifespan vs cost method is to keep the average cycle at about 50% discharge.*
- Unfortunately, it is often impossible to tell what you are really buying in some of the discount stores or places that specialize in automotive batteries. The golf car battery is quite popular for small systems and RV's. The problem is that "golf car" refers to a size of battery (commonly called GC-2, or T-105), not the type or construction - so the quality and construction of a golf car battery can vary considerably - ranging from the cheap off brand with thin plates up the true deep cycle brands, such as Crown, Deka, Trojan, etc. In general, you get what you pay for.
- **Marine** batteries are usually a "hybrid", and fall between the starting and deep-cycle batteries, though a few (Rolls-Surrette and Concorde, for example) are true deep cycle. In the hybrid, the plates may be composed of Lead sponge, but it is coarser and heavier than that used in starting batteries. It is often hard to tell what you are getting in a "marine" battery, but most are a hybrid. Starting batteries are usually rated at "CCA", or cold cranking amps, or "MCA", Marine cranking amps - the same as "CA". Any battery with the capacity shown in CA or MCA may or may not be a true deep-cycle battery. It is sometimes hard to tell, as the term deep cycle is often overused. CA and MCA ratings are at 32 degrees F, while CCA is at zero degree F. Unfortunately, the only positive way to tell with some batteries is to buy one and cut it open - not much of an option.

Using a deep cycle battery as a starting battery

There is generally no problem with this, providing that allowance is made for the lower **cranking amps** compared to a similar size starting battery. As a general rule, if you are going to use a true deep cycle battery (such as the Concorde SunXtender) also as a starting battery, it should be **oversized** about 20% compared to the existing or recommended starting battery group size to get the same cranking amps. That is about the same as replacing a group 24 with a group 31. With modern engines with fuel injection and electronic ignition, it generally takes much less battery power to crank and start them, so raw cranking amps is less important than it used to be. On the other hand, many cars, boats, and RV's are more heavily loaded with power sucking "appliances", such as megawatt stereo systems etc. that are more suited for deep cycle batteries. We have used the Concorde SunXtender AGM batteries in some of our vehicles with no problems.

It will not hurt a deep cycle battery to be used as a starting battery, but for the same size battery they cannot supply as much cranking amps as a regular starting battery.

Battery Construction Materials

Nearly all large rechargeable batteries in common use are Lead-Acid type. (There are some NiCads in use, but for most purposes the very high initial expense, and the high expense of disposal, does not justify them). The acid is typically 30% Sulfuric acid and 70% water at full charge. NiFe (Nickel-Iron) batteries are also available - these have a very long life, but rather poor efficiency (60-70%) and the voltages are different, making it more difficult to match up with standard 12v/24/48v systems and inverters. The biggest problem with NiFe batteries is that you may have to put in 100 watts to get 70 watts of charge - they are much less efficient than Lead-Acid. What you save on batteries you will have to make up for by buying a larger solar panel system. NiCads are also inefficient - typically around 65% - and very expensive. However, NiCads can be frozen without damage, so are sometimes used in areas where the temperatures may fall below -50 degrees F. Most AGM batteries will also survive freezing with no problems, even though the output when frozen will be little or nothing.

Industrial deep cycle batteries

Sometimes called "fork lift", "traction" or "stationary" batteries, are used where power is needed over a longer period of time, and are designed to be "deep cycled", or discharged down as low as 20% of full charge (80% DOD, or Depth of Discharge). These are often called traction batteries because of their widespread use in forklifts, golf carts, and floor sweepers (from which we get the "GC" and "FS" series of battery sizes). Deep cycle batteries have much thicker plates than automotive batteries.

Plate Thickness

Plate thickness (of the Positive plate) matters because of a factor called "**positive grid corrosion**". This ranks among the top 3 reasons for battery failure. The positive (+) plate is what gets eaten away gradually over time, so eventually there is nothing left - it all falls to the bottom as sediment. Thicker plates are directly related to longer life, so other things being equal, the battery with the thickest plates will last the longest. The negative plate in batteries expands somewhat during discharge, which is why nearly all batteries have separators, such as glass mat or paper, that can be compressed.

Automotive batteries typically have plates about .040" (4/100") thick, while forklift batteries may have plates more than 1/4" (.265" for example in larger Rolls-Surrette) thick - almost 7 times as thick as auto batteries. The typical golf cart will have plates that are around .07 to .11" thick. The Concorde AGM's are .115", The Rolls-Surrette L-16 type (CH460) is .150", and the US Battery and Trojan L-16 types are .090". The Crown L-16HC size has .22" thick plates. While plate thickness is not the only factor in how many deep cycles a battery can take before it dies, it is the most important one.

Most industrial (fork lift) deep-cycle batteries use Lead-Antimony plates rather than the Lead-Calcium used in AGM or gelled deep-cycle batteries and in automotive starting batteries. The Antimony increases plate life and strength, but increases gassing and water loss. This is why most industrial batteries have to be checked often for water level if you do not have Hydrocaps. The **self discharge** of batteries with Lead-Antimony plates can be high - as much as 1% per day on an older battery. A new AGM typically self-discharges at about 1-2% per month, while an old one may be as much as 2% per week.

Sealed batteries

Sealed batteries are made with vents that (usually) cannot be removed. The so-called Maintenance Free batteries are also sealed, but are not usually leak proof. Sealed batteries are not totally sealed, as they must allow gas to vent during charging. If overcharged too many times, some of these batteries can lose enough water that they will die before their time. Most smaller deep cycle batteries (including AGM) use **Lead-Calcium** plates for increased life, while most industrial and forklift batteries use **Lead-Antimony** for greater plate strength to withstand shock and vibration.

Lead-Antimony (such as forklift and floor scrubber) batteries have a much higher self-discharge rate (2-10% per week) than Lead or Lead-Calcium (1-5% per month), but the Antimony improves the mechanical strength of the plates, which is an important factor in electric vehicles. They are generally used where they are under constant or very frequent

charge/discharge cycles, such as fork lifts and floor sweepers. The Antimony increases plate life at the expense of higher self discharge. If left for long periods unused, these should be trickle charged to avoid damage from sulfation - but this applies to ANY battery.

As in all things, there are trade offs. The Lead-Antimony types have a very long lifespan, but higher self discharge rates.

Battery Size Codes

Batteries come in all different sizes. Many have "group" sizes, which is based upon the *physical size* and terminal placement. It is NOT a measure of battery capacity. Typical BCI codes are group U1, 24, 27, and 31. Industrial batteries are usually designated by a part number such as "FS" for floor sweeper, or "GC" for golf cart. Many batteries follow no particular code, and are just manufacturers part numbers. Other standard size codes are 4D & 8D, large industrial batteries, commonly used in solar electric systems.

Some common battery size codes used are: (ratings are approximate)

U1	34 to 40 Amp hours	12 volts
Group 24	70-85 Amp hours	12 volts
Group 27	85-105 Amp hours	12 volts
Group 31	95-125 Amp hours	12 volts
4-D	180-215 Amp hours	12 volts
8-D	225-255 Amp hours	12 volts
Golf Cart & T-105	180 to 225 Amp hours	6 volts
L-16, L16HC etc.	340 to 415 Amp hours	6 volts

Gelled electrolyte

Gelled batteries, or "Gel Cells" contain acid that has been "gelled" by the addition of Silica Gel, turning the acid into a solid mass that looks like gooey Jell-O. The advantage of these batteries is that it is impossible to spill acid even if they are broken. However, there are several disadvantages. One is that they must be charged at a slower rate (C/20) to prevent excess gas from damaging the cells. They cannot be fast charged on a conventional automotive charger or they may be permanently damaged. This is not usually a problem with solar electric systems, but if an auxiliary generator or inverter bulk charger is used, current **must be limited** to the manufacturers specifications. Most better inverters commonly used in solar electric systems can be set to limit charging current to the batteries.

Some other disadvantages of gel cells is that they must be charged at a lower voltage (2/10th's less) than flooded or AGM batteries. If overcharged, voids can develop in the gel which will never heal, causing a loss in battery capacity. In hot climates, water loss can be enough over 2-4 years to cause premature battery death. It is for this and other reasons that we no longer sell any of the gelled cells except for replacement use. The newer AGM (absorbed glass mat) batteries have all the advantages (and then some) of gelled, with none of the disadvantages.

AGM, or Absorbed Glass Mat Batteries

A newer type of sealed battery uses "Absorbed Glass Mats", or AGM between the plates. This is a very fine fiber Boron-Silicate glass mat. These type of batteries have all the advantages of gelled, but can take much more abuse. We sell the Concorde (and Lifeline, made by Concorde) AGM batteries. These are also called "starved electrolyte", as the mat is about 95% saturated rather than fully soaked. That also means that they will not leak acid even if broken.

AGM batteries have several advantages over both gelled and flooded, at about the same cost as gelled:

Since all the electrolyte (acid) is contained in the glass mats, they cannot spill, even if broken. This also means that since they are non-hazardous, the shipping costs are lower. In addition, since there is no liquid to freeze and expand, they are practically immune from freezing damage.

Nearly all AGM batteries are "**recombinant**" - what that means is that the Oxygen and Hydrogen recombine INSIDE the battery. These use gas phase transfer of oxygen to the negative plates to recombine them back into water while charging and prevent the loss of water through electrolysis. The recombining is typically 99+% efficient, so almost no water is lost.

The charging voltages are the same as for any standard battery - no need for any special adjustments or problems with incompatible chargers or charge controls. And, since the internal resistance is extremely low, there is almost no heating of the battery even under heavy charge and discharge currents. The Concorde (and most AGM) batteries have no charge or discharge current limits.

AGM's have a very low self-discharge - from 1% to 3% per month is usual. This means that they can sit in storage for much longer periods without charging than standard batteries. The Concorde batteries can be almost fully recharged (95% or better) even after 30 days of being totally discharged.

AGM's do not have any liquid to spill, and even under severe overcharge conditions hydrogen emission is far below the 4% max specified for aircraft and enclosed spaces. The plates in AGM's are tightly packed and rigidly mounted, and will withstand shock and vibration better than any standard battery.

Even with all the advantages listed above, there is still a place for the standard flooded deep cycle battery. AGM's will cost 2 to 3 times as much as flooded batteries of the same capacity. In many installations, where the batteries are set in an area where you don't have to worry about fumes or leakage, a standard or industrial deep cycle is a better economic choice. AGM batteries main advantages are no maintenance, completely sealed against fumes, Hydrogen, or leakage, non-spilling even if they are broken, and can survive most freezes. Not everyone needs these features.

Temperature Effects on Batteries

Battery capacity (how many amp-hours it can hold) is reduced as temperature goes down, and increased as temperature goes up. This is why your car battery dies on a cold winter morning, even though it worked fine the previous afternoon. If your batteries spend part of the year shivering in the cold, the reduced capacity has to be taken into account when sizing the system batteries. The standard rating for batteries is at room temperature - 25 degrees C (about 77 F). At approximately -22 degrees F (-27 C), battery AH capacity drops to 50%. At freezing, capacity is reduced by 20%. Capacity is increased at higher temperatures - at 122 degrees F, battery capacity would be about 12% higher.

Battery charging **voltage** also changes with temperature. It will vary from about 2.74 volts per cell (16.4 volts) at -40 C to 2.3 volts per cell (13.8 volts) at 50 C. This is why you should have temperature compensation on your charger or charge control if your batteries are outside and/or subject to wide temperature variations. Some charge controls have temperature compensation built in (such as Morningstar) - this works fine if the controller is subject to the same temperatures as the batteries. However, if your batteries are outside, and the controller is inside, it does not work that well. Adding another complication is that large battery banks make up a large **thermal mass**.

Thermal mass means that because they have so much mass, they will change internal temperature much slower than the surrounding air temperature. A large insulated battery bank may vary as little as 10 degrees over 24 hours internally, even though the air temperature varies from 20 to 70 degrees. For this reason, external (add-on) temperature sensors should be attached to one of the POSITIVE plate terminals, and bundled up a little with some type of insulation on the terminal. The sensor will then read very close to the actual internal battery temperature.

Even though battery capacity at high temperatures is higher, battery *life* is shortened. Battery capacity is reduced by 50% at -22 degrees F - but battery LIFE increases by about 60%. Battery life is reduced at higher temperatures - for every 15 degrees F over 77, battery life is cut in half. This holds true for ANY type of Lead-Acid battery, whether

sealed, gelled, AGM, industrial or whatever. This is actually not as bad as it seems, as the battery will tend to average out the good and bad times. *Click on the small graph to see a full size chart of temperature vs capacity.*

One last note on temperatures - in some places that have extremely cold or hot conditions, batteries may be sold locally that are NOT standard electrolyte (acid) strengths. The electrolyte may be stronger (for cold) or weaker (for very hot) climates. In such cases, the specific gravity and the voltages may vary from what we show.

Cycles vs Life

A battery "cycle" is one complete discharge and recharge cycle. It is usually considered to be discharging from 100% to 20%, and then back to 100%. However, there are often ratings for other depth of discharge cycles, the most common ones are 10%, 20%, and 50%. You have to be careful when looking at ratings that list how many cycles a battery is rated for unless it also states how far down it is being discharged. For example, one of the widely advertised telephone type (float service) batteries have been advertised as having a 20-year life. If you look at the fine print, it has that rating only at 5% DOD - it is much less when used in an application where they are cycled deeper on a regular basis. Those same batteries are rated at less than 5 years if cycled to 50%. For example, most golf cart batteries are rated for about 550 cycles to 50% discharge - which equates to about 2 years.

Battery life is directly related to how **deep** the battery is cycled each time. If a battery is discharged to 50% every day, it will last about twice as long as if it is cycled to 80% DOD. If cycled only 10% DOD, it will last about 5 times as long as one cycled to 50%. Obviously, there are some practical limitations on this - you don't usually want to have a 5 ton pile of batteries sitting there just to reduce the DOD. The most practical number to use is 50% DOD on a regular basis. This does NOT mean you cannot go to 80% once in a while. It's just that when designing a system when you have some idea of the loads, you should figure on an **average** DOD of around 50% for the best storage vs cost factor. Also, there is an upper limit - a battery that is continually cycled 5% or less will usually not last as long as one cycled down 10%. This happens because at very shallow cycles, the Lead Dioxide tends to build up in clumps on the the positive plates rather in an even film. The graph above shows how lifespan is affected by depth of discharge. The chart is for a Concorde Lifeline battery, but all lead-acid batteries will be similar in the shape of the curve, although the number of cycles will vary.

Battery Voltages

All Lead-Acid batteries supply about 2.14 volts per cell (12.6 to 12.8 for a 12 volt battery) when fully charged. Batteries that are stored for long periods will eventually lose all their charge. This "leakage" or self discharge varies considerably with battery type, age, & temperature. It can range from about 1% to 15% per month. Generally, new AGM batteries have the lowest, and old industrial (Lead-Antimony plates) are the highest. In systems that are continually connected to some type charging source, whether it is solar, wind, or an AC powered charger this is seldom a problem. However, one of the biggest killers of batteries is sitting stored in a partly discharged state for a few months. A "float" charge should be maintained on the batteries even if they are not used (or, **especially** if they are not used). Even most "dry charged" batteries (those sold without electrolyte so they can be shipped more easily, with acid added later) will deteriorate over time. Max storage life on those is about 2-3 years.

Batteries self-discharge faster at higher temperatures. Lifespan can also be seriously reduced at higher temperatures - most manufacturers state this as a 50% loss in life for every 15 degrees F over a 77 degree cell temperature. Lifespan is increased at the same rate if below 77 degrees, but capacity is reduced. This tends to even out in most systems - they will spend part of their life at higher temperatures, and part at lower.

Myth: The old myth about not storing batteries on concrete floors is just that - a myth. This story has been around for 100 years, and originated back when battery cases were made up of wood and asphalt. The acid would leak from them, and form a slow-discharging circuit through the now acid-soaked and conductive floor.

State of Charge

State of charge, or conversely, the depth of discharge (**DOD**) can be determined by measuring the voltage and/or the specific gravity of the acid with a hydrometer. This will NOT tell you how good (capacity in AH) the battery condition is - only a sustained **load test** can do that. Voltage on a fully charged battery will read 2.12 to 2.15 volts per cell, or 12.7 volts for a 12 volt battery. At 50% the reading will be 2.03 VPC (Volts Per Cell), and at 0% will be 1.75 VPC or less. Specific gravity will be about 1.265 for a fully charged cell, and 1.13 or less for a totally discharged cell. This can vary with battery types and brands somewhat - when you buy new batteries you should charge them up and let them sit for a while, then take a reference measurement. Many batteries are sealed, and hydrometer reading cannot be taken, so you must rely on voltage. Hydrometer readings may not tell the whole story, as it takes a while for the acid to get mixed up in wet cells. If measured right after charging, you might see 1.27 at the top of the cell, even though it is much less at the bottom. This does not apply to gelled or AGM batteries.

"False" Capacity

A battery can meet all the tests for being at full charge, yet be much lower than it's original capacity. If plates are damaged, sulfated, or partially gone from long use, the battery may give the **appearance** of being fully charged, but in reality acts like a battery of much smaller size. This same thing can occur in gelled cells if they are overcharged and gaps or bubbles occur in the gel. What is left of the plates may be fully functional, but with only 20% of the plates left... Batteries usually go bad for other reasons before reaching this point, but it is something to be aware of if your batteries seem to test OK but lack capacity and go dead very quickly under load.

On the table below, you have to be careful that you are not just measuring the surface charge. To properly check the voltages, the battery should sit at rest for a few hours, or you should put a small load on it, such as a small automotive bulb, for a few minutes. The voltages below apply to ALL Lead-Acid batteries, except gelled. For gel cells, subtract .2 volts. Note that the voltages when **actually charging** will be quite different, so do not use these numbers for a battery that is under charge.

Amp-Hour Capacity

All deep cycle batteries are rated in amp-hours. An amp-hour is one amp for one hour, or 10 amps for 1/10 of an hour and so forth. It is **amps x hours**. If you have something that pulls 20 amps, and you use it for 20 minutes, then the amp-hours used would be 20 (amps) x .333 (hours), or 6.67 AH. The accepted AH rating time period for batteries used in solar electric and backup power systems (and for nearly all deep cycle batteries) is the "**20 hour rate**". This means that it is discharged down to 10.5 volts over a 20 hour period while the total actual amp-hours it supplies is measured. Sometimes ratings at the **6 hour rate** and **100 hour rate** are also given for comparison and for different applications. The 6-hour rate is often used for industrial batteries, as that is a typical daily duty cycle. Sometimes the 100 hour rate is given just to make the battery look better than it really is, but it is also useful for figuring battery capacity for long-term backup amp-hour requirements.

Why amp-hours are specified at a particular rate:

Because of something called the Peukert Effect. The Peukert value is directly related to the internal resistance of the battery. The higher the internal resistance, the higher the losses while charging and discharging, especially at higher currents. This means that the faster a battery is used (discharged), the LOWER the AH capacity. Conversely, if it is drained slower, the AH capacity is higher. This is important because some manufacturers and vendors have chosen to rate their batteries at the 100 hour rate - which makes them look a lot better than they really are. Here are some typical battery capacities from the manufacturers data sheets:

Battery Type	100 hour rate	20 hour rate	8
Trojan T-105	250 AH	225 AH	n/a
US Battery 2200	n/a	225 AH	181 AH
Concorde PVX-6220	255 AH	221 AH	183 AH
Surrette S-460 (L-16)	429 AH	344 AH	282 AH
Trojan L-16	400 AH	360 AH	n/a
Surrette CS-25-PS	974 AH	779 AH	639 AH

State of Charge

Here are no-load typical voltages vs state of charge

(figured at 10.5 volts = fully discharged, and 77 degrees F). Voltages are for a 12 volt battery system. For 24 volt systems multiply by 2, for 48 volt system, multiply by 4. VPC is the volts per individual cell - if you measure more than a .2 volt difference between each cell, you need to equalize, or your batteries are going bad, or they may be sulfated. These voltages are for batteries that have been at rest for 3 hours or more. Batteries that are being charged will be higher - the voltages while under charge will not tell you anything, you have to let the battery sit for a while. For longest life, batteries should stay in the green zone. Occasional dips into the yellow are not harmful, but continual discharges to those levels will shorten battery life considerably. It is important to realize that ***voltage measurements are only approximate***. The best determination is to measure the specific gravity, but in many batteries this is difficult or impossible. Note the large voltage drop in the last 10%.

State of Charge	12 Volt battery	Volts per Cell
100%	12.7	2.12
90%	12.5	2.08
80%	12.42	2.07
70%	12.32	2.05
60%	12.20	2.03
50%	12.06	2.01
40%	11.9	1.98
30%	11.75	1.96
20%	11.58	1.93
10%	**11.31**	**1.89**
0	**10.5**	**1.75**

Battery Charging

Battery charging takes place in 3 basic stages: *Bulk*, *Absorption*, and *Float*.

Bulk Charge - The first stage of 3-stage battery charging. Current is sent to batteries at the maximum safe rate they will accept until voltage rises to near (80-90%) full charge level. Voltages at this stage typically range from 10.5 volts to 15 volts. There is no "correct" voltage for bulk charging, but there may be limits on the maximum current that the battery and/or wiring can take.

Absorption Charge: The 2nd stage of 3-stage battery charging. Voltage remains constant and current gradually tapers off as internal resistance increases during charging. It is during this stage that the charger puts out maximum voltage. Voltages at this stage are typically around 14.2 to 15.5 volts.

Float Charge: The 3rd stage of 3-stage battery charging. After batteries reach full charge, charging voltage is reduced to a lower level (typically 12.8 to 13.2) to reduce gassing and prolong battery life. This is often referred to as a maintenance or trickle charge, since it's main purpose is to keep an already charged battery from discharging. PWM, or "pulse width modulation" accomplishes the same thing. In PWM, the controller or charger senses tiny voltage drops in the battery and sends very short charging cycles (pulses) to the battery. This may occur several hundred times per minute. It is called "pulse width" because the width of the pulses may vary from a few microseconds to several seconds. Note that for **long term** float service, such as backup power systems that are seldom discharged, the float voltage should be around 13.02 to 13.20 volts.

Chargers: Most garage and consumer (automotive) type battery chargers are bulk charge only, and have little (if any) voltage regulation. They are fine for a quick boost to low batteries, but not to leave on for long periods. Among the regulated chargers, there are the voltage regulated ones, such as Iota Engineering and Todd, which keep a constant regulated voltage on the batteries. If these are set to the correct voltages for your batteries, they will keep the batteries charged without damage. These are sometimes called "taper charge" - as if that is a selling point. What taper charge really means is that as the battery gets charged up, the voltage goes up, so the amps out of the charger goes down. They charge OK, but a charger rated at 20 amps may only be supplying 5 amps when the batteries are 80% charged. To get around this, Statpower (and maybe others?) have come out with "smart", or multi-stage chargers. These use a variable voltage to keep the charging amps much more constant for faster charging.

Charge controllers

A charge controller is a regulator that goes between the solar panels and the batteries. Regulators for solar systems are designed to keep the batteries charged at peak without overcharging. Meters for Amps (from the panels) and battery Volts are optional with most types. Some of the various brands and models that we use and recommend are listed below. Most of the modern controllers have automatic or manual equalization built in, and many have a LOAD output. There is no "best" controller for all applications - some systems may need the bells and whistles of the more expensive controls, others may not. These are some of the charge controllers that we recommend, but almost any modern controller will work fine. Exact model will depend on application and system size and voltage.

Xantrex (All)
Morningstar (All)
Outback Power MX60 & 80
Blue Sky Energy (Solar Boost)
Steca

Using any of these will almost always give better battery life and charge than "on-off" or simple shunt type regulators

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Battery Charging Voltages and Currents:

Most flooded batteries should be charged at no more than the "C/8" rate for any sustained period. "C/8" is the battery capacity at the 20-hour rate divided by 8. For a 220 AH battery, this would equal 26 Amps. Gelled cells should be charged at no more than the C/20 rate, or 5% of their amp-hour capacity. The **Concorde AGM** batteries are a special case - the can be charged at up the the Cx4 rate, or 400% of the capacity for the bulk charge cycle. However, since very few battery cables can take that much current, we don't recommend you try this at home. To avoid cable overheating, you should stick to C/4 or less.

Charging at 15.5 volts will give you a 100% charge on Lead-Acid batteries. Once the charging voltage reaches 2.583 volts per cell, charging should stop or be reduced to a trickle charge. Note that flooded batteries **MUST** bubble (gas) somewhat to insure a full charge, and to mix the electrolyte. Float voltage for Lead-Acid batteries should be about 2.15 to 2.23 volts per cell, or about 12.9-13.4 volts for a 12 volt battery. At higher temperatures (over 85 degrees F) this should be reduced to about 2.10 volts per cell.

Never add acid to a battery except to replace spilled liquid. Distilled or deionized water should be used to top off non-sealed batteries. Float and charging voltages for gelled batteries are usually about 2/10th volt less than for flooded to reduce water loss. Note that many shunt-type charge controllers sold for solar systems will NOT give you a full charge - check the specifications first. To get a full charge, you must continue to apply a current after the battery voltage reaches the cutoff point of most of these type of controllers. This is why we recommend the charge controls and battery chargers listed in the sections above. Not all shunt type controllers are 100% on or off, but most are.

Flooded battery life can be extended if an **equalizing charge** is applied every 10 to 40 days. This is a charge that is about 10% higher than normal full charge voltage, and is applied for about 2 to 16 hours. This makes sure that all the cells are equally charged, and the gas bubbles mix the electrolyte. If the liquid in standard wet cells is not mixed, the electrolyte becomes "stratified". You can have very strong solution at the bottom, and very weak at the top of the cell. With stratification, you can test a battery with a hydrometer and get readings that are quite a ways off. If you cannot equalize for some reason, you should let the battery sit for at least 24 hours and then use the hydrometer. AGM and gelled should be equalized 2-4 times a year at most - check the manufacturers recommendations, especially on gelled.

Battery Aging

As batteries age, their maintenance requirements change. This means longer charging time and/or higher finish rate (higher amperage at the end of the charge). Usually older batteries need to be watered more often. And, their capacity decreases.

Mini Factoids

Nearly all batteries will not reach full capacity until cycled 10-30 times. A brand new battery will have a capacity of about 5-10% less than the rated capacity.

Batteries should be watered **after** charging unless the plates are exposed, then add just enough water to cover the plates. After a full charge, the water level should be even in all cells and usually 1/4" to 1/2" below the bottom of the fill well in the cell (depends on battery size and type).

In situations where multiple batteries are connected in series, parallel or series/parallel, replacement batteries should be the same size, type and manufacturer (if possible). Age and usage level should be the same as the companion batteries. Do not put a new battery in a pack which is more than 6 months old or has more than 75 cycles. Either replace with all new or use a good used battery. For long life batteries, such as the Surrette and Crown, you can have up to a one year age difference.

The vent caps on flooded batteries should remain on the battery while charging. This prevents a lot of the water loss and splashing that may occur when they are bubbling.

When you first buy a new set of flooded (wet) batteries, you should fully charge and equalize them, and then take a hydrometer reading for future reference. Since not all batteries have exactly the same acid strength, this will give you a baseline for future readings.

When using a small solar panel to keep a float (maintenance) charge on a battery (without using a charge controller), choose a panel that will give a maximum output of about 1/300th to 1/1000th of the amp-hour capacity. For a pair of golf cart batteries, that would be about a 1 to 5 watt panel - the smaller panel if you get 5 or more hours of sun per day, the larger one for those long cloudy winter days in the Northeast.

Lead-Acid batteries do NOT have a memory, and the rumor that they should be fully discharged to avoid this "memory" is totally false and will lead to early battery failure.

Inactivity can be extremely harmful to a battery. It is a **VERY** poor idea to buy new batteries and "save" them for later. Either buy them when you need them, or keep them on a continual trickle charge. The best thing - if you buy them, use them.

Only clean water should be used for cleaning the outside of batteries. Solvents or spray cleaners should not be used.

Some Peukert Exponent values (not complete, just for info). We don't have a lot of data. Trojan T-105 = 1.25; Optima 750S = 1.109; US Battery 2200 = 1.20.

The above information courtesy of www.windsun.com an excellent source for solar equipment!!!

How do solar cells work to produce electricity ?

Solar power in a nutshell

Solar cells consist of wafers of silicon and boron (two natural earth elements) sandwiched together that have a positive charge. Meaning they have more than one free electron on the surface. They also have wires attached between the wafers to collect any power produced. The electrons are locked in place until they are struck by sunlight.

Sunlight produces photons and when a solar cell is struck by sunlight a reaction takes place and the photons push the extra electrons from the wafers through the wires and produce a current of electricity.

For example: when you walk across carpet in rubber soled shoes you create heat that transfers extra electrons to your shoes and body. When you touch a metal object like a doorknob (or another person that is touching the ground) you create a path for the static electricity to flow and ZAP! The same principle applies loosely to solar power.

Solar cells are linked together by wires to produce higher amounts of electricity and the electricity is measured in watts and volts.

Solar cells are protected by panels that consist of a clear glass front to allow sunlight to strike the solar cells and a protective metal case usually made from aluminum to hold it all together.

The individual solar cell wires are tied together to larger wires that exit the from the panel and these wires will have one positive wire and one negative wire.

When placed in direct sunlight a solar panel cell will begin producing power immediately and this power is collected through the wires to a storage battery.

For a very detailed description of how solar cells work read on or jump to the next chapter.

Detailed description of solar cells

“You've probably seen calculators that have solar cells -- calculators that never need batteries, and in some cases don't even have an off button. As long as you have enough light, they seem to work forever. You may have seen larger solar panels -- on emergency road signs or call boxes, on buoys, even in parking lots to power lights.

Although these larger panels aren't as common as solar powered calculators, they're out there, and not that hard to spot if you know where to look. There are solar cell arrays on satellites, where they are used to power the electrical systems.

You have probably also been hearing about the "solar revolution" for the last 20 years -- the idea that one day we will all use free electricity from the sun. This is a seductive promise: On a bright, sunny day, the sun shines approximately 1,000 watts of energy per square meter of the planet's surface, and if we could collect all of that energy we could easily power our homes and offices for free.

In this article, we will examine solar cells to learn how they convert the sun's energy directly into electricity. In the process, you will learn why we are getting closer to using the sun's energy on a daily basis, and why we still have more research to do before the process becomes cost effective.

The solar cells that you see on calculators and satellites are photovoltaic cells or modules (modules are simply a group of cells electrically connected and packaged in one frame). Photovoltaics, as the word implies (photo = light, voltaic = electricity), convert sunlight directly into electricity. Once used almost exclusively in space, photovoltaics are used more and more in less exotic ways. They could even power your house. How do these devices work?

Photovoltaic (PV) cells are made of special materials called semiconductors such as silicon, which is currently the most commonly used. Basically, when light strikes the cell, a certain portion of it is absorbed within the semiconductor material. This means that the energy of the absorbed light is transferred to the semiconductor. The energy knocks electrons loose, allowing them to flow freely. PV cells also all have one or more electric fields that act to force electrons freed by light absorption to flow in a certain direction. This flow of electrons is a current, and by placing metal contacts on the top and bottom of the PV cell, we can draw that current off to use externally. For example, the current can power a calculator. This current, together with the cell's voltage (which is a result of its built-in electric field or fields), defines the power (or wattage) that the solar cell can produce.

That's the basic process, but there's really much more to it. Let's take a deeper look into one example of a PV cell: the single-crystal silicon cell.

How Silicon Makes a Solar Cell

Silicon has some special chemical properties, especially in its crystalline form. An atom of silicon has 14 electrons, arranged in three different shells. The first two shells, those closest to the center, are completely full. The outer shell, however, is only half full, having only four electrons. A silicon atom will always look for ways to fill up its last shell (which would like to have eight electrons). To do this, it will share electrons with four of its neighbor silicon atoms. It's like every atom holds hands with its neighbors, except that in this case, each atom has four hands joined to four neighbors. That's what forms the crystalline structure, and that structure turns out to be important to this type of PV cell.

We've now described pure, crystalline silicon. Pure silicon is a poor conductor of electricity because none of its electrons are free to move about, as electrons are in good conductors such as copper. Instead, the electrons are all locked in the crystalline structure. The silicon in a solar cell is modified slightly so that it will work as a solar cell.

A solar cell has silicon with **impurities** -- other atoms mixed in with the silicon atoms, changing the way things work a bit. We usually think of impurities as something undesirable, but in our case, our cell wouldn't work without them. These impurities are actually put there on purpose. Consider silicon with an atom of phosphorous here and there, maybe one for every million silicon atoms. Phosphorous has five electrons in its outer shell, not four. It still bonds with its silicon neighbor atoms, but in a sense, the phosphorous has one electron that doesn't have anyone to hold hands with. It doesn't form part of a bond, but there is a positive proton in the phosphorous nucleus holding it in place.

When energy is added to pure silicon, for example in the form of heat, it can cause a few electrons to break free of their bonds and leave their atoms. A hole is left behind in each case. These electrons then wander randomly around the crystalline lattice looking for another hole to fall into. These electrons are called **free carriers**, and can carry electrical current. There are so few of them in pure silicon, however, that they aren't very useful. Our impure silicon with phosphorous atoms mixed in is a different story. It turns out that it takes a lot less energy to knock loose one of our "extra" phosphorous electrons because they aren't tied up in a bond -- their neighbors aren't holding them back. As a

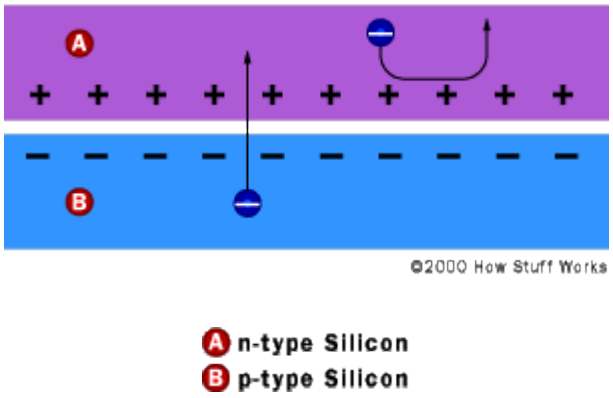
result, most of these electrons do break free, and we have a lot more free carriers than we would have in pure silicon. The process of adding impurities on purpose is called **doping**, and when doped with phosphorous, the resulting silicon is called **N-type** ("n" for negative) because of the prevalence of free electrons. N-type doped silicon is a much better conductor than pure silicon is.

Actually, only part of our solar cell is N-type. The other part is doped with boron, which has only three electrons in its outer shell instead of four, to become **P-type** silicon. Instead of having free electrons, P-type silicon ("p" for positive) has free holes. Holes really are just the absence of electrons, so they carry the opposite (positive) charge. They move around just like electrons do.

The interesting part starts when you put N-type silicon together with P-type silicon. Remember that every PV cell has at least one **electric field**. Without an electric field, the cell wouldn't work, and this field forms when the N-type and P-type silicon are in contact. Suddenly, the free electrons in the N side, which have been looking all over for holes to fall into, see all the free holes on the P side, and there's a mad rush to fill them in.

Anatomy of a Solar Cell

Before now, our silicon was all electrically neutral. Our extra electrons were balanced out by the extra protons in the phosphorous. Our missing electrons (holes) were balanced out by the missing protons in the boron. When the holes and electrons mix at the **junction** between N-type and P-type silicon, however, that neutrality is disrupted. Do all the free electrons fill all the free holes? No. If they did, then the whole arrangement wouldn't be very useful. Right at the junction, however, they do mix and form a barrier, making it harder and harder for electrons on the N side to cross to the P side. Eventually, equilibrium is reached, and we have an electric field separating the two sides.



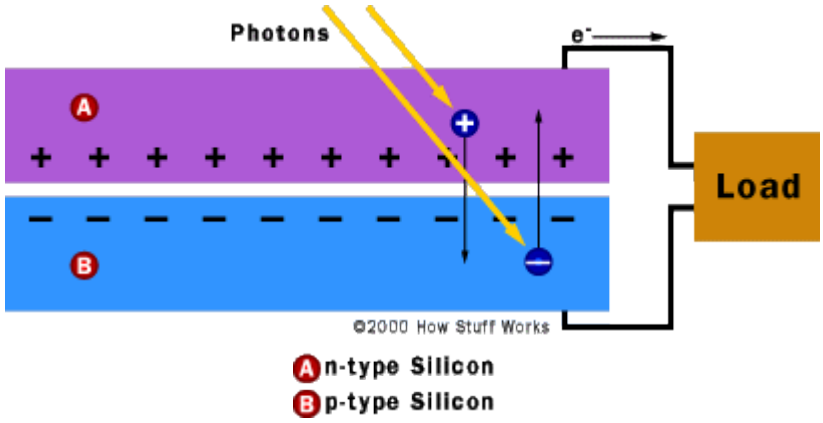
The effect of the electric field in a PV cell

This electric field acts as a diode, allowing (and even pushing) electrons to flow from the P side to the N side, but not the other way around. It's like a hill -- electrons can easily go down the hill (to the N side), but can't climb it (to the P side).

So we've got an electric field acting as a diode in which electrons can only move in one direction.

When light, in the form of photons, hits our solar cell, its energy frees electron-hole pairs.

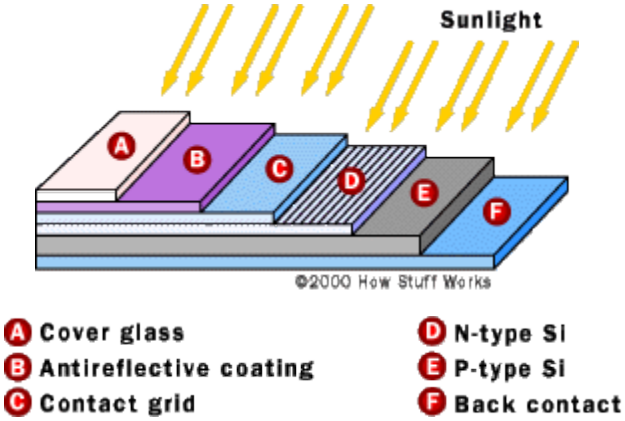
Each photon with enough energy will normally free exactly one electron, and result in a free hole as well. If this happens close enough to the electric field, or if free electron and free hole happen to wander into its range of influence, the field will send the electron to the N side and the hole to the P side. This causes further disruption of electrical neutrality, and if we provide an external current path, electrons will flow through the path to their original side (the P side) to unite with holes that the electric field sent there, doing work for us along the way. The electron flow provides the **current**, and the cell's electric field causes a **voltage**. With both current and voltage, we have **power**, which is the product of the two.



Operation of a PV cell

There are a few more steps left before we can really use our cell. Silicon happens to be a very shiny material, which means that it is very reflective. Photons that are reflected can't be used by the cell. For that reason, an **antireflective coating** is applied to the top of the cell to reduce reflection losses to less than 5 percent.

The final step is the **glass cover plate** that protects the cell from the elements. PV modules are made by connecting several cells (usually 36) in series and parallel to achieve useful levels of voltage and current, and putting them in a sturdy frame complete with a glass cover and positive and negative terminals on the back.



Basic structure of a generic silicon PV cell

How much sunlight energy does our PV cell absorb? Unfortunately, the most that our simple cell could absorb is around 25 percent, and more likely is **15 percent or less**. Why so little?

Energy Loss in a Solar Cell

Visible light is only part of the electromagnetic spectrum. Electromagnetic radiation is not monochromatic -- it is made up of a range of different wavelengths, and therefore energy levels. (See How Special Relativity Works for a good discussion of the electromagnetic spectrum.)

Light can be separated into different wavelengths, and we can see them in the form of a rainbow. Since the light that hits our cell has photons of a wide range of energies, it turns out that some of them won't have enough energy to form an electron-hole pair. They'll simply pass through the cell as if it were transparent. Still other photons have too much energy. Only a certain amount of energy, measured in electron volts (eV) and defined by our cell material (about 1.1 eV for crystalline silicon), is required to knock an electron loose. We call this the band gap energy of a material. If a photon has more energy than the required amount, then the extra energy is lost (unless a photon has twice the required energy, and can create more than one electron-hole pair, but this effect is not significant). These two effects alone account for the loss of around 70 percent of the radiation energy incident on our cell.

Why can't we choose a material with a really low band gap, so we can use more of the photons? Unfortunately, our band gap also determines the strength (voltage) of our electric field, and if it's too low, then what we make up in extra current (by absorbing more photons), we lose by having a small voltage. Remember that power is voltage times current. The optimal band gap, balancing these two effects, is around **1.4 eV** for a cell made from a single material.

We have other losses as well. Our electrons have to flow from one side of the cell to the other through an external circuit. We can cover the bottom with a metal, allowing for good conduction, but if we completely cover the top, then photons can't get through the opaque conductor and we lose all of our current (in some cells, transparent conductors are used on the top surface, but not in all). If we put our contacts only at the sides of our cell, then the electrons have to travel an extremely long distance (for an electron) to reach the contacts. Remember, silicon is a semiconductor -- it's not nearly as good as a metal for transporting current. Its internal resistance (called series resistance) is fairly high, and high resistance means high losses. To minimize these losses, our cell is covered by a metallic contact grid that shortens the distance that electrons have to travel while covering only a small part of the cell surface. Even so, some photons are blocked by the grid, which can't be too small or else its own resistance will be too high.

Now that we know how a solar cell operates, let's see what it takes to power a house with the technology.

Solar-powering a House

What would you have to do to power your house with solar energy? Although it's not as simple as just slapping some modules on your roof, it's not extremely difficult to do, either.

First of all, not every roof has the correct **orientation** or **angle of inclination** to take advantage of the sun's energy. Non-tracking PV systems in the Northern Hemisphere should point toward true south (this is the orientation). They should be inclined at an angle equal to the area's latitude to absorb the maximum amount of energy year-round. A different orientation and/or inclination could be used if you want to maximize energy production for the morning or afternoon, and/or the summer or winter. Of course, the modules should never be shaded by nearby trees or buildings, no matter the time of day or the time of year. In a PV module, even if just one of its 36 cells is shaded, power production will be reduced by more than half.

If you have a house with an unshaded, south-facing roof, you need to decide what size system you need. This is complicated by the facts that your electricity production depends on the weather, which is never completely predictable, and that your electricity demand will also vary. These hurdles are fairly easy to clear. **Meteorological data** gives average monthly sunlight levels for different geographical areas. This takes into account rainfall and cloudy days, as well as altitude, humidity, and other more subtle factors. You should design for the worst month, so that you'll have enough electricity all year. With that data, and knowing your average household demand (your utility bill conveniently lets you know how much energy you use every month),there are simple methods you can use to determine just how many PV modules you'll need. You'll also need to decide on a system voltage, which you can control by deciding how many modules to wire in series.

You may have already guessed a couple of problems that we'll have to solve. First, what do we do when the sun isn't shining?

Solving Solar-power Issues

Certainly, no one would accept only having electricity during the day, and then only on clear days, if they have a choice. We need **energy storage** -- batteries. Unfortunately, batteries add a lot of cost and maintenance to the PV system. Currently, however, it's a necessity if you want to be completely independent. One way around the problem is to connect your house to the utility grid, buying power when you need it and selling to them when you produce more than you need. This way, the utility acts as a practically infinite storage system. The utility has to agree, of course, and in most cases will buy power from you at a much lower price than their own selling price. You will also need special equipment to make sure that the power you sell to your utility is synchronous with theirs -- that it shares the same sinusoidal waveform and frequency. Safety is an issue as well. The utility has to make sure that if there's a power outage in your neighborhood, your PV system won't try to feed electricity into lines that a lineman may think is dead. This is called **islanding**.

If you decide to use batteries, keep in mind that they will have to be maintained, and then replaced after a certain number of years. The PV modules should last 20 years or more, but batteries just don't have that kind of useful life. Batteries in PV systems can also be very dangerous because of the energy they store and the acidic electrolytes they contain, so you'll need a well-ventilated, non-metallic enclosure for them.

Although several different kinds of batteries are commonly used, the one characteristic they should all have in common is that they are **deep-cycle batteries**. Unlike your car battery, which is a shallow-cycle battery, deep-cycle batteries can discharge more of their stored energy while still maintaining long life. Car batteries discharge a large current for a very short time -- to start your car -- and are then immediately recharged as you drive. PV batteries generally have to discharge a smaller current for a longer period (such as all night), while being charged during the day.

The most commonly used deep-cycle batteries are **lead-acid** batteries (both sealed and vented) and **nickel-cadmium** batteries. Nickel-cadmium batteries are more expensive, but last longer and can be discharged more completely without harm. Even deep-cycle lead-acid batteries can't be discharged 100 percent without seriously shortening battery life, and generally, PV systems are designed to discharge lead-acid batteries no more than 40 percent or 50 percent.

Also, the use of batteries requires the installation of another component called a **charge controller**. Batteries last a lot longer if care is taken so that they aren't overcharged or drained too much. That's what a charge controller does. Once the batteries are fully charged, the charge controller doesn't let current from the PV modules continue to flow into them. Similarly, once the batteries have been drained to a certain predetermined level, controlled by measuring battery voltage, many charge controllers will not allow more current to be drained from the batteries until they have been recharged. The use of a charge controller is essential for long battery life." -Aldous, Scott. "How Solar Cells Work." 01 April 2000. <http://www.howstuffworks.com/solar-cell.htm> 07 December 2009.

What is a solar panel and which ones work best ?

Solar panel types

Solar panels are a collection of solar cells that have wires attached to each cell and run through a common wire. The cells are mounted in a protective panel that consists of a clear glass front and a box frame usually made from aluminum.

Not all cells and not all panels are equal so choosing a panel should be based on the construction of the cell, construction of the panel and the output of electricity from the panel.

Solar cells come in three common forms:

Monocrystalline cells are single continuous cells made from silicon and boron wafers.

Multicrystalline cells are small pieces of silicon and boron wafers glued together.

Amorphous semiconductor are a non-crystalline semiconductor material. Easier and cheaper to make than crystalline, but less efficient and slowly degrades over time. Also called thin film. They are not recommended for off-grid homes.

Monocrystalline cells are more expensive to produce and will produce more power in direct sunlight than multicrystalline solar cells. Panels with monocrystalline cells usually cost more and the extra power output would only be beneficial to homes that get a lot of good direct sunlight even in winter.

Multicrystalline solar cells are less expensive and will produce more power than monocrystalline cells in low sunlight conditions. Multicrystalline solar panels would be better for homes where winter sun may be blocked by clouds.

I use multicrystalline solar panels at my cabin because we get a lot of overcast winter days when I need more power. In the summer the polycrystalline cells will still do a fine job of collecting the direct sunshine and produce more power than I need.

If you live in a very sunny location that rarely has overcast days then monocrystalline cells may be worth the extra money!

Panel Construction

Most but not all panels are constructed in a similar way.

The cells are attached to a backing of EVA and TPT polymers (plastics) that can withstand years of exposure to sunlight and withstand chemical reactions from outside sources.

The frame is usually made of aluminum and the best panels use anodized aluminum in which the aluminum is placed in a chemical bath and an electrical current is passed through it to causing it to anodize or rust creating a strong surface that will withstand the outside elements and weather.

The glass on a good panel will usually be safety glass to prevent breaking by hail storms and is the same glass used in storm windows and patio doors. It will also be low iron content glass which allows more sunlight penetration.

Here is the manufacturers description of the 120 watt Solartech panel I recently purchased:

Click to learn more about this panel

120 Watt Multicrystalline Silicon PV Solar Panel 12V

Model Number: ASM120P-N
This 120 watt Solar Panel is UL Listed: UL certification **No.E330673**

6(in) Multi-crystalline solar cell

Low iron tempered glass (LIT Glass)

It is a safety glass, it breaks into hundreds of small, relatively harmless pieces instead of long, sharp shards. Tempered glass is much stronger than regular window glass, and is required in building codes for patio and shower doors. Tempered glass cannot be cut with any conventional glass cutter. Taking the iron out of the glass gives it a light transmittance of about 91 percent. Regular glass has a transmittance of about 83 percent. This 8 percent difference can be very significant over the thirty to fifty year life of a solar collector or module. Solar collectors and PV modules operate at efficiencies directly proportional to the amount of light that gets through the glass

EVA laminated + TPT backsheet

Junction box comes with 3 ft DC cable.

Anodized aluminum frame:

Aluminum can actually be made stronger and more durable through a process called 'anodizing'. Anodizing involves placing a sheet of aluminum into a chemical acid bath, quite often acetone in laboratory experiments. The sheet of aluminum becomes the positive anode of a chemical battery and the acid bath becomes the negative. An electric current passes through the acid, causing the surface of the aluminum to oxidize (essentially rust). The oxidized aluminum forms a strong coating as it replaces the original aluminum on the surface. The result is an extremely hard substance called anodized aluminum

What to look for in a solar panel

We have discussed the cells and panel construction you should look for, but now lets discuss the panel power output!

Solar electricity is measured using three different measurement terms. The power is the same but the measurement and how the measurement is used is different:

Volts indicates the basic unit of power being produced and is similar to how much water pressure you have when you turn on a garden hose.

Amperes or Amps is the current of power produced and is similar to the flow rate (how fast) that water travels through the hose.

Watts is the quantity of power moving through a wire at any given time.

Watts = Volts X Amps Amps = Watts / Volts

We will talk about these terms more in depth when we look at determining the size of system needed for a home.

These are the manufacturers specifications for the 120 watt Solartech solar panel I recently purchased . Below each specification in parenthesis is a description of what each specification means.

Specifications for 120 Watt Solartech Panel:

Nominal Voltage: 12 Volts

(Panels produce a range of voltage with lots of peaks and drops and the nominal voltage is the median range. The actual voltage may be anywhere from 18 volts to 10 volts)

Maximum Power at STC: 120 Watts

(This is the watts rating produced by the panel at a set temperature point. This panel is rated for 120 watts at a temperature of 77 F. Standard Test Conditions (STC)--Conditions under which a module is typically tested in a laboratory.)

Optimum operating voltage: 18.0 Volts

(This is the voltage produced by the panel at the set temperature point. You will notice it is higher than 12 volts and that is because the voltage will be reduced by wires, the controller and connection to the battery to the actual 12 -14 volts required.)

Optimum operating current: 7.11 Amp

(Amps are another measurement of power and this panel will produce 7.11 amps at the set temperature point)

Open circuit voltage: 21.9 Volts

(The maximum possible voltage across a photovoltaic cell or module; the voltage across the cell in sunlight when no current is flowing.)
Short circuit current: 7.68Amp

(The current flowing freely from a photovoltaic cell through an external circuit that has no load or resistance; the maximum current possible.)

Cell Multicrystalline Silicon Solar Cells: 156mm x 156mm

No. of Cells and Connections: 36(4x9)

Dimension of Module: 58.3in x 26.6in x 1.97in

Weight (Panel Only): 29.7 lbs

Solar Panel Grade: A

Module Efficiency: 12.47%

Operating temperature: - 40 to +85 C

Maximum system voltage: 1000 VDC
(this is the maximum number of panel watts that should be combined using these panels)

Type of output terminal: Junction box

Cable Length: 3 ft.

Connection: open end

Application for this Solar Module:

12 Volt DC Battery Charger, Weather Towers Power, Camping and Hunting, RV, Marine Power Supply (Yacht, Boat) , Wind Hybrid Systems, Truck Auxiliary Power Unit, Landscaping (Garden Lights), Remote Area Applications

What to look for when buying a solar panel

1) When I buy a solar panel I look first at the type of solar cell. Polycrystalline cells are less expensive and work well in low sunlight conditions. Monocrystalline cells are only fore excellent sunlight areas even in winter

2) I look for the UL rating meaning it has been tested in a US laboratory and the ratings for the solar panel are accurate

3) I look at the Nominal voltage rating and determine if it is a 12 volt or 24 volt panel to match my system

4) I look at the Maximum Power STC for the actual Watts the panel will produce at 77 F.

5) I look at the Amps rating to see how big of a power controller it will require

6) I look at the panel specifications for safety glass and low Iron glass

7) I look at the specifications for EVA laminated and TPT back sheet

8) I look at the frame for Anodized Aluminum and wire connections for copper insulated wires

CHAPTER FIVE

Choosing and Purchasing solar Equipment

If you have used the worksheets and tables in the previous chapters to determine the size of solar electric system you need then you are ready to choose and purchase your equipment. If you have not completed the worksheets then you can use this information for ideas on prices but please do not purchase equipment without first determining the size of system you will need or you may be wasting money or end up with an oversized or undersized system!

You have determined that you need so many watts of solar panels to meet your daily power needs so enter that number from your worksheets here _____.

We have discussed the different types of panels (monocrytaline, multicrystaline, and amorphous) so enter the type of solar cell you are looking for here _____.

You have determined if you will use a 12 volt or 24 volt system so enter that here _____.

With that information you can now look at soar panels, charge controllers, inverters and batteries to see which will best fit your application.

Charge Controllers

Charge controllers come in three types standard shunt, MPPT (Maximum Power Point Tracking), and Grid Tie. http://www.windsun.com/ChargeControls/ChargeCont.htm

All charge controllers monitor the power output from the panels and the battery to keep batteries from overcharging and keep power from the panels to the batteries at a constant rate.

MPPT controllers also regulate the current of the power to the batteries to optimize the charging and prevent sulfuring and off gassing of the batteries.

"Maximum Power Point Tracking is electronic tracking - usually digital. The charge controller looks at the output of the panels, and compares it to the battery voltage. It then figures out what is the best power that the panel can put out to charge the battery. It takes this and converts it to best voltage to get maximum AMPS into the battery. (Remember, it is Amps into the battery that counts). Most modern MPPT's are around 93-97% efficient in the conversion. You typically get a 20 to 45% power gain in winter and 10-15% in summer. Actual gain can vary widely depending weather, temperature, battery state of charge, and other factors. " http://www.windsun.com/ChargeControls/MPPT.htm

For very small systems a standard shunt charge controller will work and is less expensive but for more power and longer battery life an MPPT charge controller is recommended.

Which ever type of charge controller you use is up to you but you must use a charge controller!

Inverters

An inverter converts the DC direct current from batteries to AC alternating current so you can run standard appliances from your system. They come in two main types: modified sine wave and true sine wave.

Modified sine wave inverters will run almost all household appliances with the exception of some sensitive electronics equipment. They are less expensive than true sine wave inverters. True sine wave inverters are recommended if running fridges, water pumps, and hi tech electronics equipment.

You will want an inverter that will handle the amount of watts you will use at a given time and for most off-grid homes a 1000- 3000 watt inverter is sufficient and smaller systems may need less. My own inverter is 400 watts!

Sizing your Charge Controller

Once you have determined the amount of power in watts you will need from your panels convert that to amps by dividing the watts by 12 volts:

Amps = watts / volts

Your charge controller must be able to handle that many amps and it is recommended that you allow extra for adding additional solar panels in the future. You can also use multiple smaller charge controllers with separate feed from panels and to batteries. Charge controllers are described by amps and type in advertising so choose carefully!

For example: My solar panels combined produce 470 watts. 470 divided by 12 = 39.2 amps so I want a 40 amp charge controller or higher. I use two 30 amp charge controllers and separate feeds for each so I can add additional panels in the future.

Sizing your Inverter

Inverters are rated by watts and volts. Once you have determined your daily watts needed for your appliance from the worksheets you will know how many watts you need from an inverter to run those appliances. Keep in mind that most appliances do not run 24/7 and many are used for just minutes a day.

For example: My only appliances that get long term run time are my lights, tv and laptop. They consume about 200 watts together. I run other appliances like a vacuum, radio, water pump, and gadgets sporadically and as long as I don't try to run everything all at once I can run everything off a 400 watt inverter.

Using a smaller inverter means you will need to be more careful of your use and not plug everything in all at once or the inverter will kick off until you unplug some appliances.

Should I buy individual panels and equipment or a complete system ?

Sometimes it is better to buy a complete system because equipment is already matched to work together but the price for a complete system is usually higher than for the separate pieces of equipment. It is a good idea to look at complete systems for ideas on equipment and then price the pieces separately to see if you can save some money!

Solar Panels and Complete Systems

There are many panel retailers out there and these are just a few for ideas and price comparisons.

SUN ELECTRONICS
MAKING SOLAR COST EFFECTIVE
Phoenix: (602) 955-5248
Miami: (305) 536-9917
Tucson: (520) 818-4302
Address: 511 NE 15th Street, Miami, FL 33132, USA

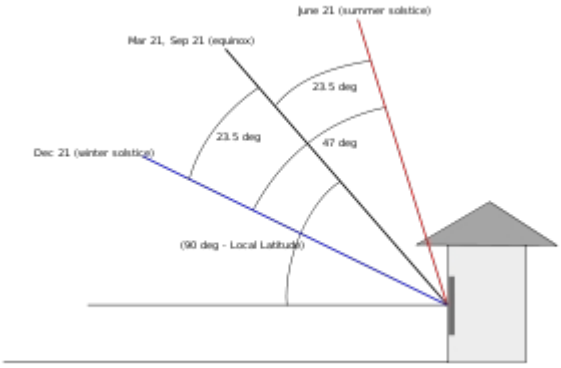
Installing Solar Equipment

Installing Solar Panels

Installing panels can be done in several ways: roof mounted panels are the most common, pole mounted, ground mounted and portable mount systems are also used in off-grid applications.

Regardless of which type of mounting system you use the big factor to consider is where to mount the panels so they get the best sunlight possible!

Where the sun goes ?



Your solar panels must be mounted where they will get maximum sunlight from morning until night. If you have south facing roof (North if you live down under) then you are in luck because that is probably the best place to mount your panels.

The sun rises in the East and sets in the West (for northern hemisphere) and travels in an arc across the sky. In summer the sun may seem to travel almost directly over head while in winter the sun travels a much lower arc depending on where you live.

For permanent mounted panels you want your panels to face true south which is different than magnetic south. True South is the direction the sun is facing at noon on any given day and is not determined by magnetic poles of the earth.

There are a lot of hi tech ways to determine true south using declination maps but a tried and true way used by most solar installers is called the shadow test.

All you need is a long stick or a nearby telephone pole to determine true south. Bury the stick in the ground and level it in all directions or find a good telephone pole to watch. At exactly solar noon 12:00pm (solar noon determined below) look at the shadow cast from the pole and stick and that shadow is pointing at true south!

This can be a little tricky to do on a roof but the same thing can be done with a pencil or ruler or weighted string held in front of the panels and aiming the panels at the shadow from the pencil or ruler or string bob. Don't worry if you are off slightly as it probably won't make that much difference to be noticeable in power production but get as close to True South as you can.

It would be best to determine True South in mid winter around January 1rst so your panels will produce the most power when you need it in winter time, but if that is not possible do it anytime of year using the solar noon time for your area (see link below) and you will still be within close enough range to get the most from your panels.

The sun will stay consistent in its arc for many years to come so if you aim your panels as close to true south as you can get then don't worry about it!

To find out the exact time for solar noon for your area here is a tool from NOAA to do that:
http://www.esrl.noaa.gov/gmd/grad/solcalc/

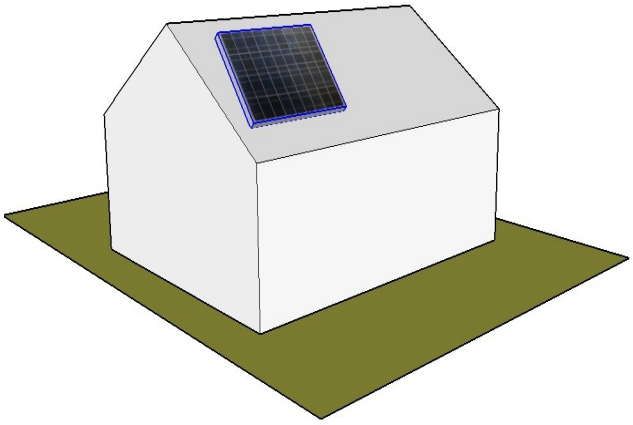
Solar Angle

Now that you have determined true south for your panels you also have to decide on what angle you will mount the panels.

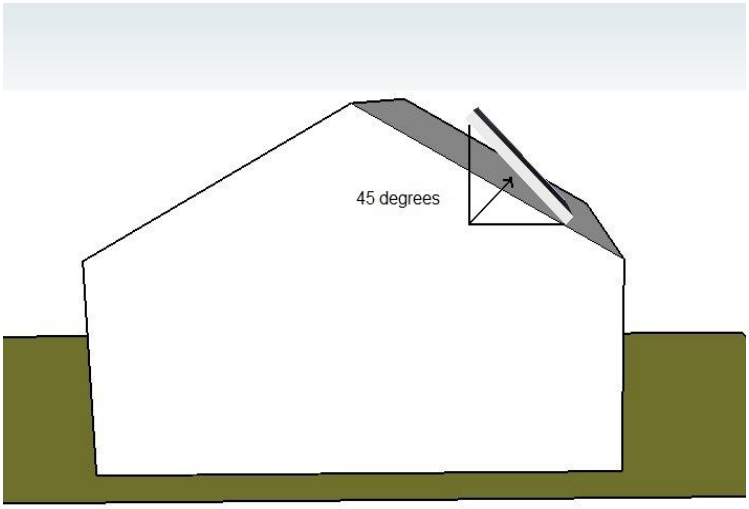
Remember the sun is usually very high in summer and can be very low in winter so if you want more power in winter and you sized your system for winter then you want your panels to have an angle to catch the most winter sun.

A general rule for solar installers is to angle the panels to 45 degrees so that they will catch the most winter sun rays and still catch the majority of summer sun rays when you need less direct sunlight for the same amount of power production.

Some mounting systems allow you to change the angle of the panels for summer and winter use but most permanent mounted panels are set at 45 degrees all year round.



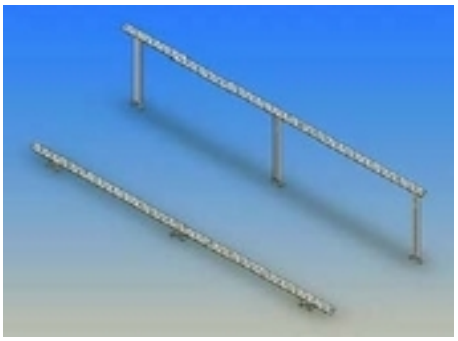
Solar panel set on south face directed at true south



Solar panel angled to 45 degrees to optimize sun exposure

Types of Roof /Ground Mounts

These types of mounts are universal for most panels and either roof or ground mounting"



Universal Roof/Ground Mount

These mounts come with specific instructions for attaching the mount o the ground or roof and these instructions must be followed to prevent damage to the panels, the house, and to you!

What if my roof doesn't face true south ?

Then you need to build a new house- just kidding!

True south will give you the best sunlight for solar panels but if your home faces magnetic south or is only slightly off from true south it will still work and panels can be angled to make up for the slight difference on the roof.

If your roof face is way off from true south then you may mount panels on the ground or a pole.

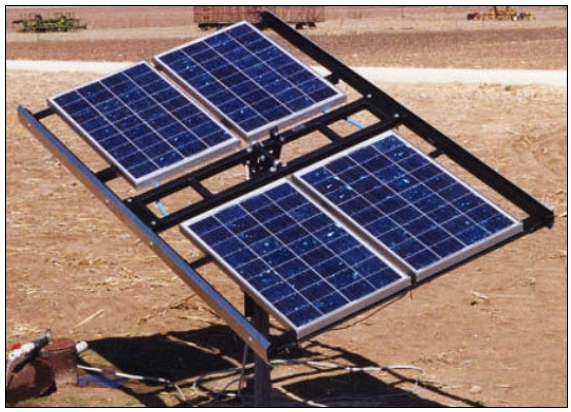
Pole Mount Panels

There are two types of pole mount systems: permanent mount and tracking.

Permanent mount may allow you to swivel the panels manually to adjust the panels to the path and angle of the sun at different times of the year.

Tracking panels are motorized and use an infrared eye to automatically position the panels for best production.

Universal Top-of-Pole Mount



Mounting panels on a roof can be dangerous!

There may be other power lines above roofs, hidden wiring and vents inside roofs, and of course there is a danger of falling or attaching a mount insufficiently and damaging the house or panels.

ALWAYS follow the instructions included with the mounts and use extreme caution on roofs!

Many off-gridders mount their own panels all the time and some even construct their own mounting systems but above all be careful and if using home made mounts only use materials like anodized steel or aluminum that will be strong and hold up under long term weather conditions!

Portable Solar Trailers

These have the convenience of being portable for people that want to use solar power at home and a vacation cabin and make it easy to reposition the panels to optimize solar power production!

They include panels, charge controller, inverter and batteries in one nice tow-able package and can be purchased commercially or constructed by any handy DIY person.

An inexpensive trailer like this could easily be converted to a portable solar trailer by building a sturdy box on top to house your batteries, charge controller, and inverter. Panels mounted on top and you have a portable power source for your home, cabin and even camping!

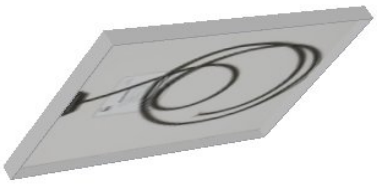
Connecting the system

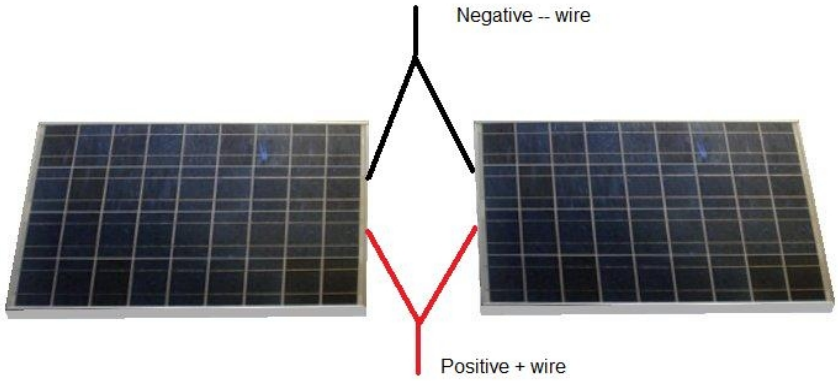
Solar panels may have MC plug and play connectors or insulated wires coming from the back of the panel. Panels have a blocking diode built into them to keep power from going back to the panel so they are made to connect to each other in series or parallel connection.

For a 12 volt system using 12 volt panels the panels are connected in parallel which means negative wires are connected to negative wires and positive wires are connected to positive wires. This also applies to 24 volt panels and a 24 volt system.

For 24 volt systems using 12 volt panels the panels are connected in series with two panels connected positive to negative and the negative wire from one panel connected to the power controller and the positive wire connected from the other panel connected to the power controller (see pictures).

For this example we will use a Kyocera 80 watt panel which is typical of most panels:

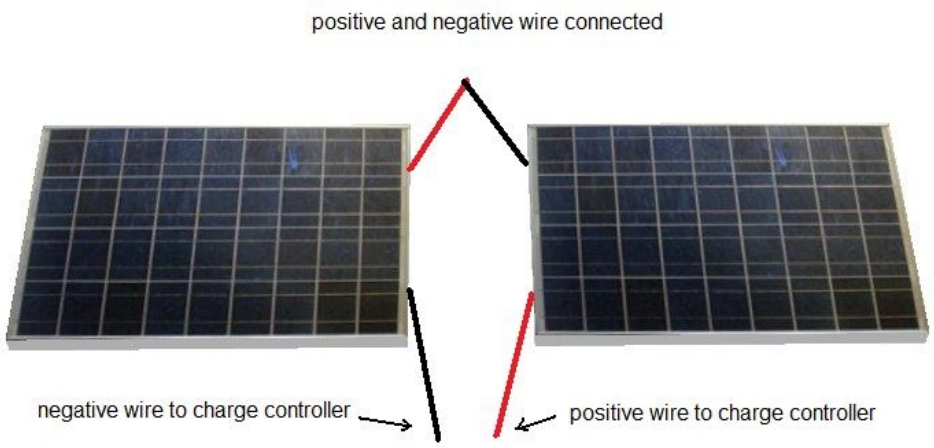




A typical 12 volt panel connection for a 12 volt system or 24 volt panel connection for a 24 volt system. Panels are connected in parallel with positive to positive wire and Negative to negative wire.

To connect wires a terminal bus bar is recommended:

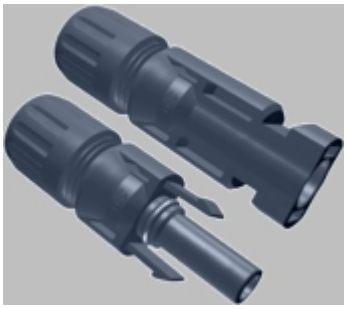
Typical 24 Volt Series Connections



For a 24 volt system using 12 volt panels one positive wire is connected to one negative wire from the other panel and one positive wire from one panel and one negative wire from the other panel goes to the power controller.

Wiring Sizes

Some panels have MC connectors like shown below and can be connected together easily:



For general wiring of panels #8 gage outdoor wire is recommended:

For battery interconnect wiring #4 AWG wire is recommended:

Breakers, combiner boxes and fuses

Fuses are generally only recommended for larger systems over 48 volts and are required for grid tie systems.

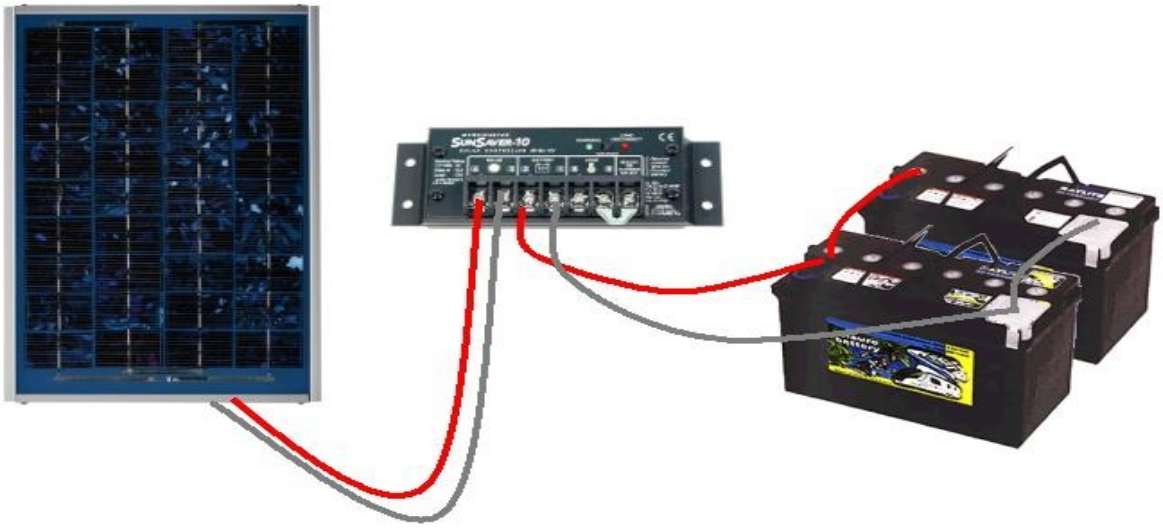
For 12 to 48 volt systems with many multiple panels a combiner box with breakers is recommended. This will allow you to organize wire runs neatly and allow easier trouble shooting. For small system with just a few panels the wiring can be run from the terminal bus bar or directly from panels to the charge controller.

Wiring the Charge Controller, Panels and Batteries

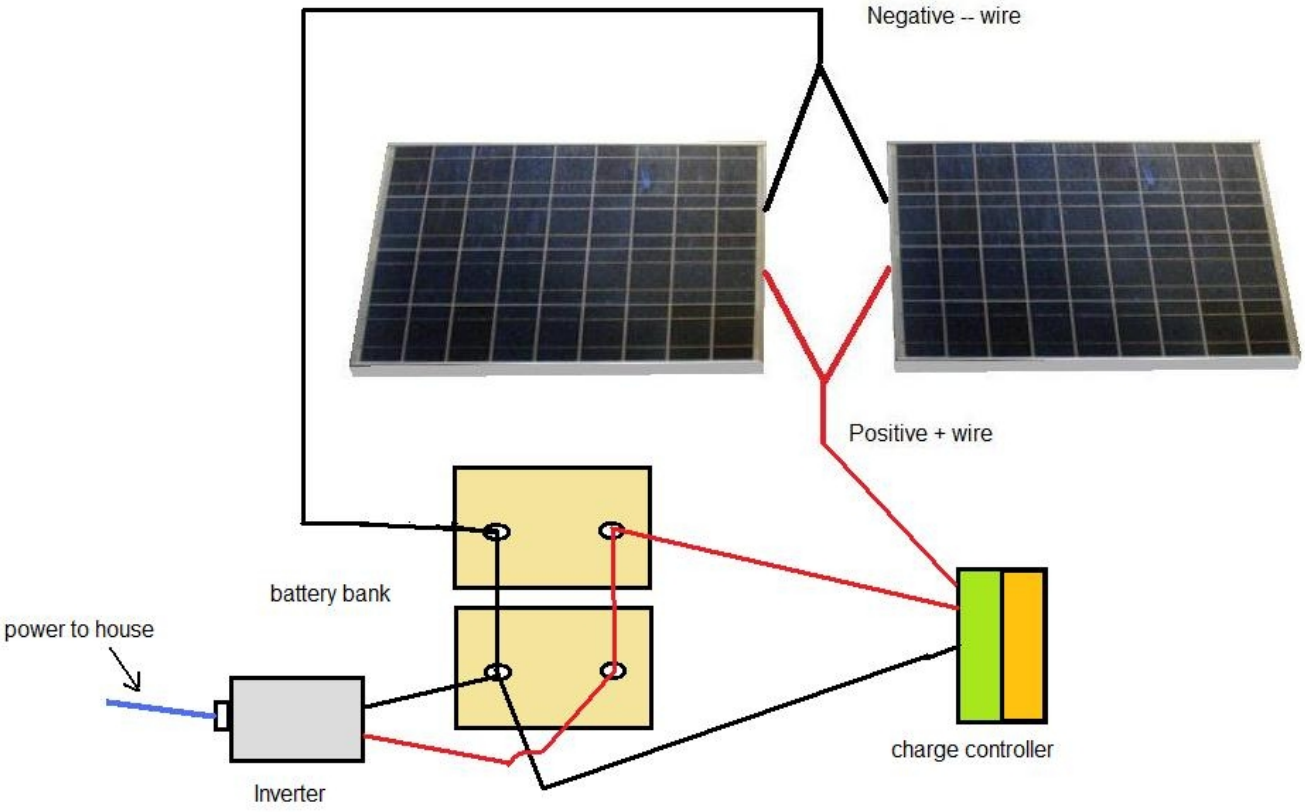
Each charge controller comes with its own wiring diagram which must be followed exactly.

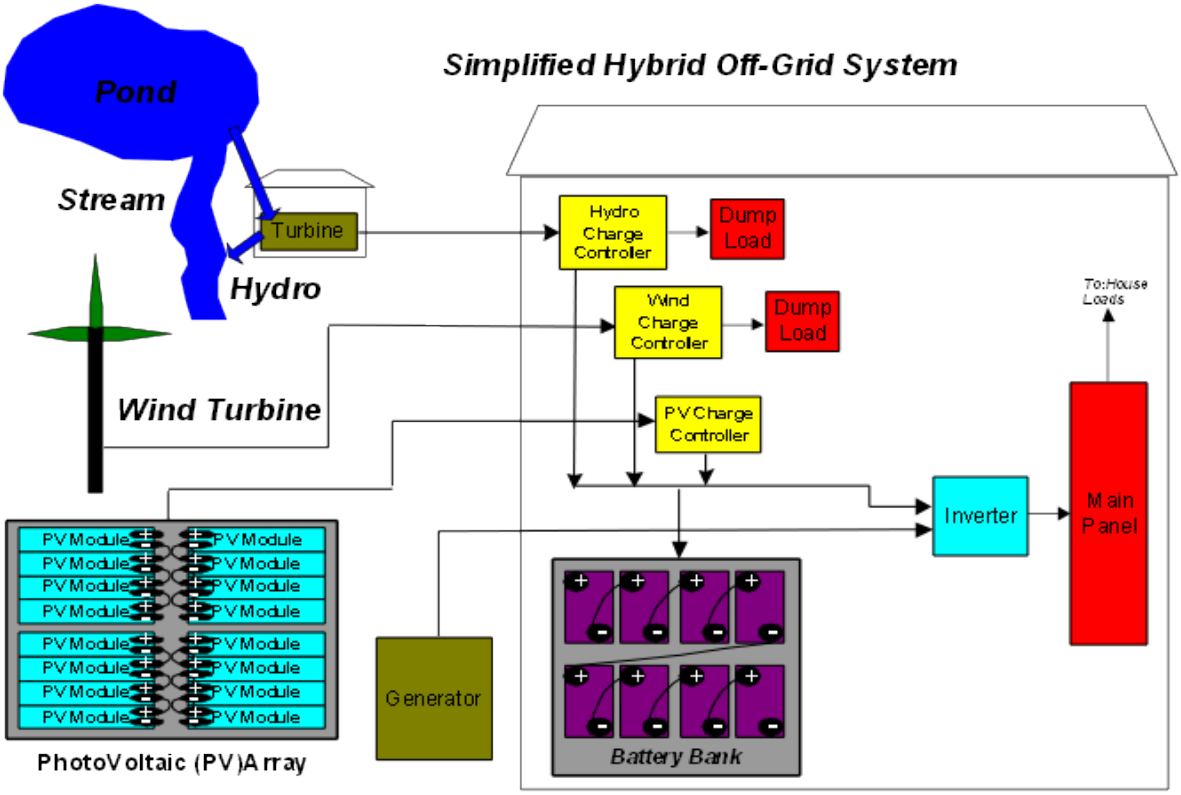
This is only a general idea of typical wiring and you must use the wiring diagram supplied with your equipment!!

Single Panel Wiring:



Multiple Panel Wiring:

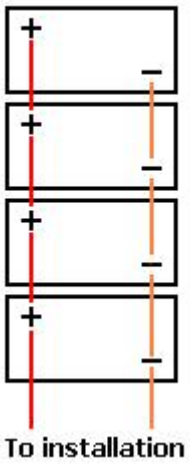




Battery Bank Parallel Connections

For any **off grid renewable energy system** the **battery bank** is probably the most important component. It doesn't matter how much power you generate - if it is not stored safely and efficiently then you will have no electricity when you need it. Batteries are also one of the most expensive parts of wind , solar , and hydro power generation systems so they need to be well cared for.

Unless you have a very small system you will need more than one battery - therefore you will need to connect the batteries to one another to form a **battery bank**. Below is an illustration from *SmartGuage Electronics* showing how this is often done:



The Problem

Because of the small amount of resistance in the cable used to interconnect the batteries, and from the connection between the cable and the battery posts, the battery closest to the installation is charged the most, discharged the most, and worked harder, whereas the battery furthest from the installation is charged the least, discharged the least, and worked the least.

The Reason

The power from the bottom battery has to pass through the main connection leads whereas the power from the top battery has to pass through the main connection leads and another four sets of interconnecting leads. Although the resistances are tiny - it is the fact that they are so small that makes them have such a big effect on the current flowing to each battery.

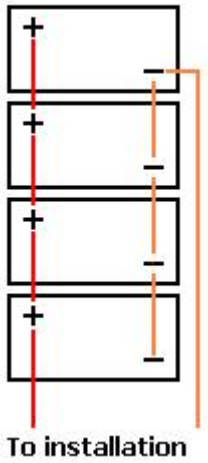
SmartGuage Electronics used a computer simulation in 1990 to calculate the following assuming a battery internal resistance of 0.02 Ohms, interconnecting lead resistance of 0.0015 Ohms per link, and a total load on the batteries of 100 amps:

The bottom battery provides 35.9 amps.
The next battery up provides 26.2 amps.
The next battery up provides 20.4 amps.
The top battery provides 17.8 amps.

...which means the battery closest to the installation is worked twice as hard as the battery at the top of the battery bank! These surprising findings have since been reproduced in real world situations.

Connecting Batteries in a Battery Bank

So it the example given above shows you **how NOT to connect batteries** to make a **battery bank**, how should you do it? It is actually very simple - instead of taking the negative AND positive feeds from the same battery (in the example above it was from the bottom battery) , you should take one feed from each end of the interconnected battery bank - e.g. +ve from the top battery and -ve from the bottom battery. See the image below from *SmartGuage Electronics*:



With the same example load of 100 amps presented above the new loads on each battery are as follows:

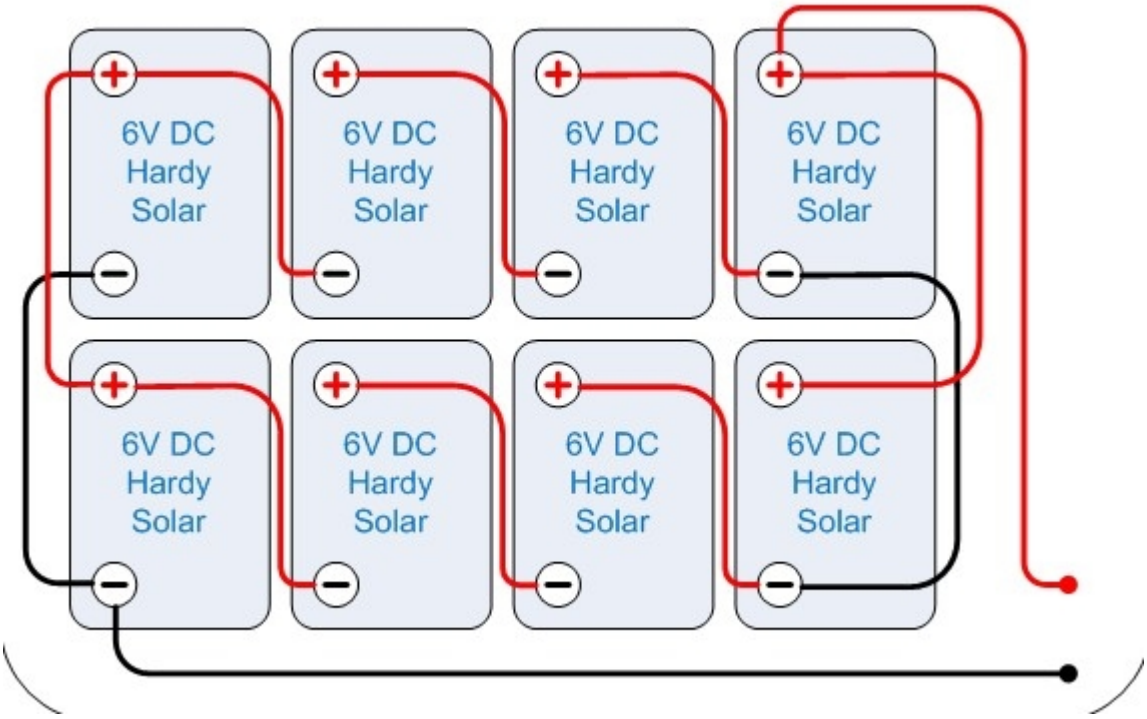
The bottom battery provides 26.7 amps.
The next battery up provides 23.2 amps.
The next battery up provides 23.2 amps.
The top battery provides 26.7 amps.

To get the batteries perfectly balanced requires a different scheme involving a little more work and expense (more cables and connections required), but is only really necessary if you have very expensive batteries or a more than 6 or so batteries in your bank.

Warning: Be Safe When Handling Lead Acid Batteries

When handling **lead acid batteries**, great care must be taken. You should always wear gloves and safety goggles because if acid sprays or spills from a battery onto your skin or eyes you could sustain a serious and permanent injury. Invest in a bottle of surgical eye wash and leave it next to your battery bank at all times so you can flush your eyes immediately if you get acid in your eye.

6 volt batteries in Series to produce 48 volts:



6 volt batteries in series to produce 24 volts:

Where to get Batteries ?

Because batteries are heavy and shipping expensive buying batteries locally is usually your best option.

Prices will vary with the type of battery and manufacturer but here are some recommendations:

Trojan T105 6 Volt

Concorde AGM 12 Volt

Deka AGM 12 Volt

Crown industrial 12 Volt

Where to Store Batteries

Batteries should be kept cool in summer and warm in winter for longer life and optimum power. Batteries produce toxic and explosive gases so an outside storage box is necessary.

You can easily make your own battery storage box out of any good wood or heavy duty plastic box and I use an old wood foot locker to store my batteries:

Maintenance

Solar electric system are fairly maintenance free but do need occasional maintenance and repairs. Batteries must be monitored at least once a week and wet cell batteries need more monitoring.

Panels are very sturdy and built to last 25 years or longer but to keep them producing power and have a long life there are some basic maintenance activities:

Clean the glass: Use an all purpose glass cleaner or hose and some soft paper or cloth towels to remove dust and bird droppings. Panels should be checked daily and cleaned as necessary. Do not scratch the glass!

Remove snow: Panels won't produce under a blanket of snow so sweep and scrape away ice and snow buildup.

Check Wiring: When you clean your panels always check wiring for frays or loose connections and repair as needed.

Refill Batteries: If you are using flooded cell batteries you will need to check the cells and refill with distilled water as needed. Batteries can evaporate water quickly and a dry battery is a dead battery. Never add acid to batteries.

Check Battery wiring: When refilling or at least once a week check battery wiring for shorts or loose connections and repair as needed.

Replace Batteries: Most deep cycle batteries will give 5 years of good service or longer but eventually all batteries use up the plates inside and will need to be replaced. Use a volt meter and test the battery under load (with an appliance attached) and if it does not hold a charge of 12 volts or higher (6 volts for 6 volt batteries) it may need to be replaced.

Check Charge Controller: Generally a charge controller needs little maintenance except to keep it clean and dry and re-tighten wire connections occasionally. Follow the manufacturers recommendations for any error readings.

Check Inverter: Generally an inverter requires very little maintenance except to keep it clean and dry and allow plenty of air circulation around it. Re-tighten any wire connections as needed and follow the manufacturers recommendations for trouble shooting the inverter.

Tools for Maintenance:

Volt Meter to test connections

Distilled Water for Batteries

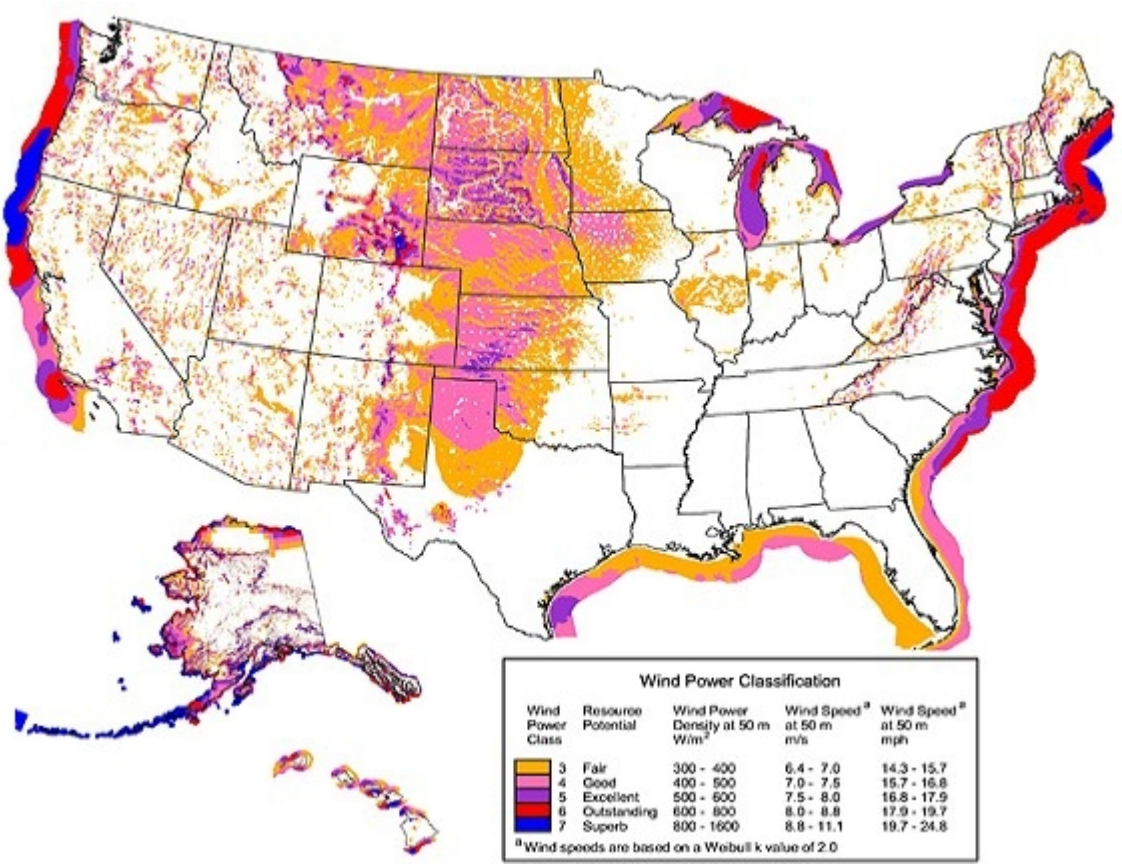
Standard Tool Set

Adding Wind Power and Generator Power

Why Wind ?

Solar Power works excellent and can be used all year round but there are places that get very low sunlight in winter and if you get enough wind in winter you can use it to keep your batteries full.

First you need to determine if you get enough wind in your area to use a wind generator. Use this map to determine average wind in your state (sorry no world maps for wind available):


Wind Power Classification
Wind Power Class
Resource Potential
Wind Power Density at 50 m W/m²
Wind Speed[a] at 50 m m/s
Wind Speed[a] at 50 m mph
3 Fair 300 - 400 6.4 - 7.0 14.3 - 15.7
4 Good 400 - 500 7.0 - 7.5 15.7 - 16.8
5 Excellent 500 - 600 7.5 - 8.0 16.8 - 17.9
6 Outstanding 600 - 800 8.0 - 8.8 17.9 - 19.7
7 Superb 800 - 1600 8.8 - 11.1 19.7 - 24.8
[a] Wind speeds are based on a Weibull k value of 2.0

You can click on the map to pull up detailed wind information for your area

Wind turbine generators

Wind turbines come in a variety of sizes, volts, and applications so choose one that will work for your application:

Sunforce 12-Volt 400-Watt Wind Generator

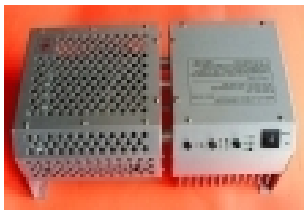
Sunforce wind Max Marine/Land

Windmax 1,200 Watt 24-Volt

Wind Charge Controllers

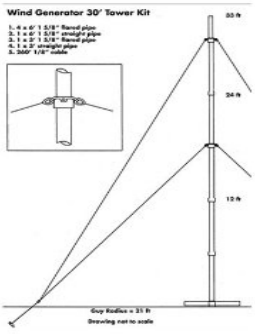
Unlike solar panels that can be shut off without damaging the panels wind turbines require a constant load or they will free spin in the wind damaging the turbine.

A wind turbine charge controller is needed to keep a load on the turbine and provide some way to dump off excess power from the turbine when the batteries are full.



Wind and Solar Hybrid Charge Controller

Wind charge controllers are usually hybrid controllers and can be used for both wind and solar combined systems. Solar charge controllers are only for solar electric systems and are not used for wind or hybrid systems.



The Tower

Wind turbines must be high and away from any wind obstructions, Roof mounting is not recommended and a tower 30 feet or taller is the recommended installation.

Commercial wind towers are available- click on picture

Installing a Wind Turbine

Info courtesy of Air Breeze: http://airbreeze.com/index.php?q=resource-center/installation

Once you have determined that you have the right conditions for a wind system, you will need to consider the best place on your property. Proper siting is critical to the performance and longevity of your investment. Poor siting in excessively turbulent conditions causes fatigue, damage and shortens a generator's working life.

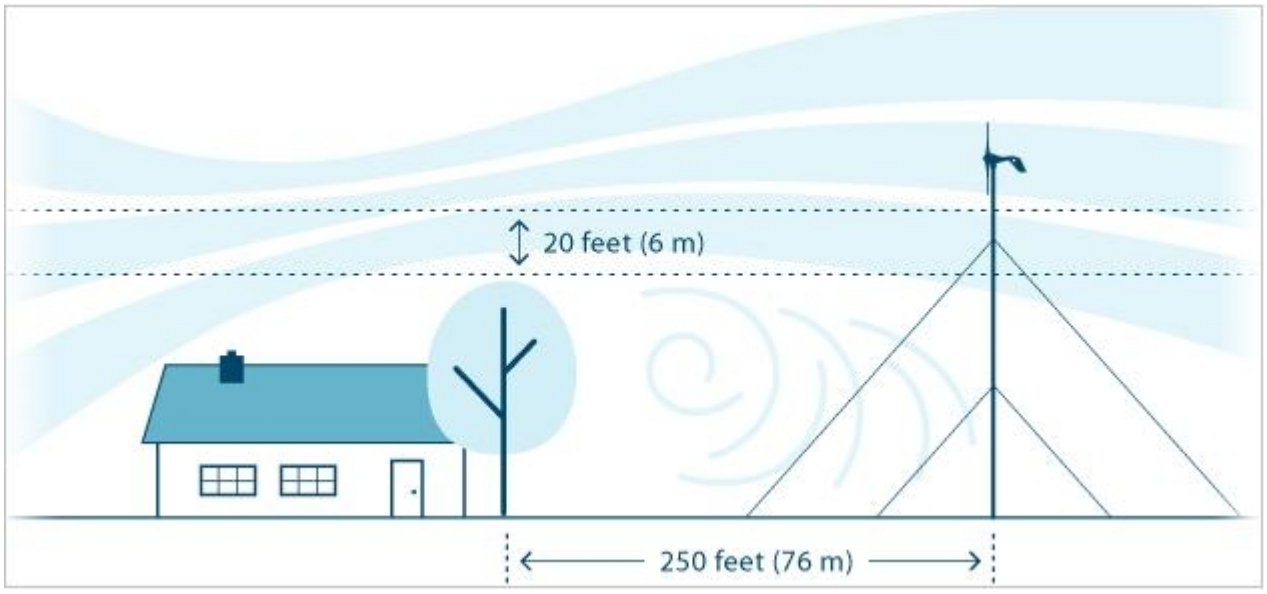
STEP 1: Determining your wind resource

There are several ways to ensure you have at least a 10 mph (4.5 m/s) average wind speed

1. Wind Maps (USA) / Wind Maps (International)
2. Local authorities such as weather stations
3. Checking your surrounding trees for indication strong wind flagging
4. Site assessment and monitoring by professional third parties

STEP 2: Locating the system on your property

Small Changes in wind speed can have a dramatic effect on power production. The siting of your wind turbine should be carefully considered. Each installation is different and is often a compromise between the tower height, distance from the battery bank and obstacles such as buildings and trees.



STEP 3: Ensure proper tower height

In general, the taller the tower, the greater the wind speed and ultimately power production. However, towers are expensive and can easily exceed the cost of the turbine.

Safety is must be the primary concern when selecting the mounting location. Install Air Breeze so there is no possibility of accidental contact with rotating blades even if it requires installing the wind turbine in a less than ideal location. Safety has precedence over efficiency.

Tower Options

There are a number of tower choices for Air Breeze. Depending on your application and site needs, you will find there is a kit that can work for you.

Marine Tower Kit

The marine tower kit is specifically designed to aid mounting the turbine on a boat deck. Kit includes powder coated aluminum mast and stays, vibration damping mounts and all necessary marine grade hardware to install.

27 ft (8 m) Guyed Tower

Tower kit includes a tower clamp/guy wire assembly and all necessary hardware and fasteners to erect a 27’ tilt-up tower using pipe or tubing with an outside diameter or 1.875”

29 ft (8.8 m) EZ Tower

A complete kit that includes all materials required to assemble a 29’ guyed wire tilt-up tower. Anchors, guy wire assemblies, galvanized steel tubing and all fasteners are included with the kit.

45 ft (14 m) Guyed Tower

The Tower kit includes tower clamp/guy wire assemblies and all necessary hardware and fasteners to erect a 45’ tilt-up tower using pipe or tubing with an outside diameter of 1.875”

Air Breeze makes some great Wind Turbines at a very affordable price and has a long history of reliability. Thay also have several downloads to help you with installation: http://airbreeze.com

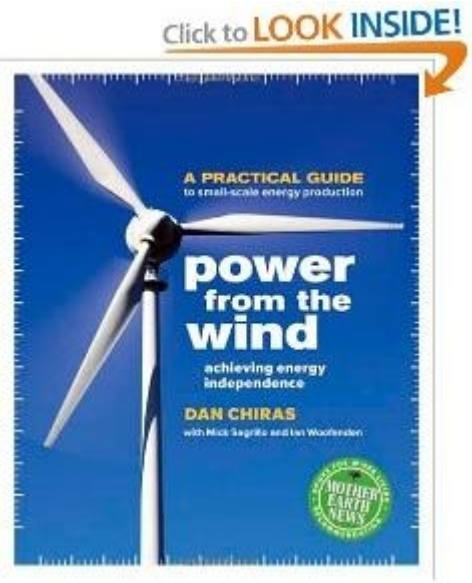
Downloads

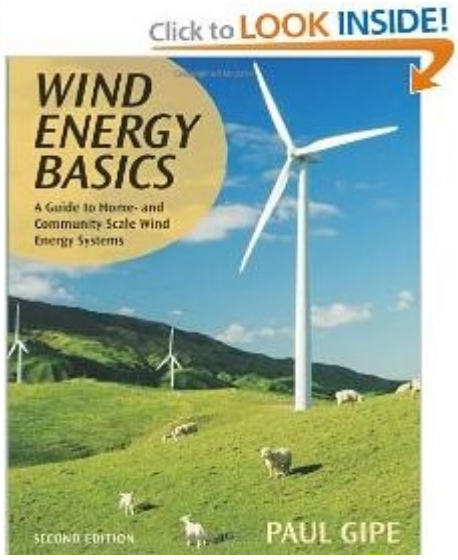
- Air Breeze Specifications
- Air Breeze Owner's Manual English (PDF)
- Air Breeze Manual Español (PDF)
- Air Breeze Manual Français (PDF)
- Air Breeze Owner's Manual Deutsch (PDF)
- Air Breeze Owner's Manual Português (PDF)
- Air Breeze IEC Certification (PDF)
- 27' Tower Manual
- 29' EZ Tower Manual
- 45' Tower Manual
- Roof Mount Manual
- Marine Tower Manual
- Wire Sizing Diagram

Sunforce 12 Volt 400 Watt Turbine

Available from Amazon $549.95

If you have some mechanical skills and want to build your own wind turbine all the parts you need are available on Ebay: [Ebay Wind Turbine Parts]

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A Guide to Home- and Community-Scale Wind Energy Systems
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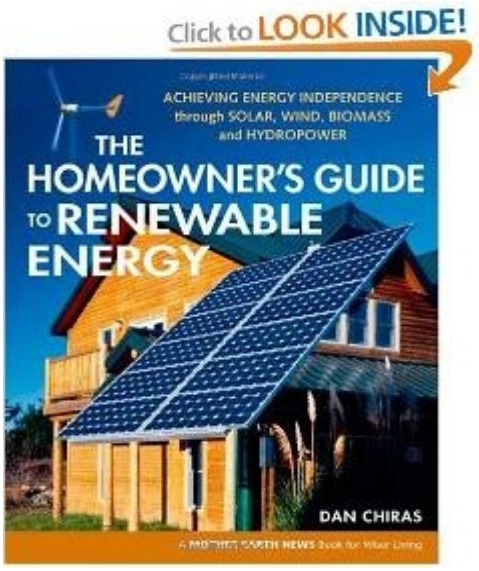
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Videos:

How to Build a Wind Turbine with PVC Windmill Blades.flv

blueeyeboy87 11 videos Subscribe

How to Build A Wind Generator (Do-It-Youself)

HowToSolarPanels 2 videos Subscribe

The Generator

Most off-grid homes have a generator for back up power that is used to recharge batteries on low sunlight days, power very large appliances and tools.

Generators come in a wide variety of models, watts produced, and type of fuel used.

Gas Generators: The most common and usually less expensive. For most off-grid homes a 4000-10,000 watt generator is sufficient.

Diesel Generators: Fuel is less expensive but more difficult to store and may have trouble running in cold weather.

Propane generators: fuel is usually less expensive and stores well. Quieter operation and no gas fumes.

Where can I get Federal and Stare Incentives to help pay for my system ?

What are Incentives and Tax rebates ?

As of writing this book December 20th, 2009 there are many Federal and State Incentives and tax Rebates available to help people purchase and install solar electric and wind home power systems.

Federal tax rebates: This is a Federal program that will pay 30% of your equipment and installation costs. Keep your receipts and use the Federal information on this website and map to claim your tax rebate:

Click on your state

State Incentives: many states also offer great incentives for installing solar and wind power systems. You will need to find the incentives available for your state and apply for the incentive using the state website information.

Other rebates: You can also claim tax rebates for federal and state if you install certain types of low energy appliances, new insulation, windows, etc. Use the website to find what products qualify and how to get the rebate:

ENERGY STAR

Federal Tax Credits for Consumer Energy Efficiency

If you purchase an energy-efficient product or renewable energy system for your home, you may be eligible for a federal tax credit. Click on the star to find an overview of the federal tax credits for energy efficiency.

Glossary

- **Alternating current (a.c.)**: Electric current in which the direction of the flow is reversed at frequent intervals, 100 times per second in Europe (50 cycles per second) and 120 times per second in the USA. Opposite of a.c. is direct current (d.c.).

- **Balance of systems (BOS)**: The parts of the photovoltaic system other than the PV array: switches, controls, meters, power-conditioning equipment, supporting structure for the array and storage components, if any. The cost of land is sometimes included when comparing total system cost with the cost of other energy sources.
- **Battery**: For off-grid systems a battery is used to provide energy storage. Nearly all batteries used for PV systems are of the lead-acid type (with a small quantity of antimony to reduce self-discharge). Nickel-cadmium batteries are also suitable and have the advantage that they cannot be overcharged or discharged, but are considerably more expensive. All PV batteries are deep-cycle i.e. designed to be discharged down to 50% or more without damage so that they can supply power over a long period of time (in contrast to a car battery, for example, which is usually only discharged down to 3 to 5 %).
  The lifetime of a battery varies depending on factors such as how it is used, how it is maintained and charged, and temperature, but is typically between 5 and 10 years.
- **Charge controller**: Charge controllers are typically used in off-grid photovoltaic power systems. The primary function of a charge controller (or regulator) is to maintain the battery at the highest possible State Of Charge (SOC) and provide the user with the required quantity of electricity, while protecting the battery from deep discharge (by the loads) or extended overcharge (by the PV array). Most charge controllers operate via voltage regulation set points. However, as voltage is not representative of the true SOC, new algorithms are being developed to evaluate the state of the battery, based on Ah or combined VAh monitoring. Additional features such as battery temperature or wire compensation, meters and alarms can enhance the ability of the charge controller to meet the load demand and extend battery lifetime. Other functions such as MPPT, d.c./d.c. conversion, anti-theft protection, load management, pre-payment and data logging can also now be built into the charge controller.
- **Demonstration programme**: Project to demonstrate the operation of photovoltaic power systems and their application to potential users/owners.
- **Direct current (d.c.)**: Electric current in which electrons are flowing in one direction only. Opposite of alternating current (a.c.).
- **Energy payback time**: The time required for any energy producing system or device to produce as much useful energy as was consumed in its manufacture and construction. For PV the energy payback times is 2 to 4 years.
- **Final annual yield**: Total photovoltaic energy delivered to the load during one year per kilowatt of power installed. Unit: kWh per kW installed.
- **Grid**: Network of transmission lines, substations, distribution lines and transformers used by central power systems
- **Grid-connected distributed photovoltaic power system**: System installed on consumers' premises usually on the demand side of the electricity meter. This includes grid-connected domestic photovoltaic power systems and other grid-connected photovoltaic power systems on commercial buildings, motorway sound barriers, etc. These may be used for support of the utility distribution grid.
- **Grid-connected centralized photovoltaic power system**: power production system performing the function of a centralized power station (also said centralized photovoltaic power plant).

- **Installed power**: Power delivered by a photovoltaic module or a photovoltaic array, under standard test conditions (irradiance of 1 000 W/m², cell junction temperature of 25°C, AM1,5 solar spectrum). Also said STC output power. Unit: W.
- **Inverter**: Device that converts direct current (d.c.) into alternating current (a.c.).
- **I-V curve**: A graphical presentation of the current versus the voltage from a photovoltaic cell as the load is increased from the short circuit (no load) condition to the open circuit (maximum voltage) condition. The shape of the curve characterizes cell performance.
- **kWh**: Symbol of kilowatt-hour, unit of energy (power expressed in kW multiplied by time expressed in hours)
- **Load**: The amount of electric power being consumed at any given moment. Also, in an electrical circuit, any device or appliance that is using power. The load for a utility company varies greatly with time of day and to some extent with season.
- **Mounting structure**: With the rapid growth of grid-connected distributed systems, a wide range of products have been developed for installing PV modules on buildings. These include mounting structures for PV facades, roof profiles, flat roofs and even 'PV tiles' that can be used to replace conventional roof tiles. New products are addressing the need for ease of integration into the building envelope and aesthetic appeal.
- **Off-grid domestic photovoltaic power system**: System installed in households and villages that are not connected to the utility grid. Usually, a means to store electricity is used (most commonly lead-acid battery). Also said "stand-alone photovoltaic power system".
- **Off-grid non-domestic photovoltaic power system**: System used for a variety of applications such as water pumping, remote communications, telecommunication relays, safety and protection devices, etc. which are not connected to the utility grid. Usually a means to store electricity is used. Also said "stand-alone photovoltaic power system".
- **Open-circuit voltage (*V*oc)**: The voltage across a photovoltaic cell or module in sunlight when no current is flowing; the maximum possible voltage. Unit: V.
- **Peak power**: PV modules are rated by their total power output. The peak power is the amount of power output a PV modules produces at Standard test conditions (STC) of a module operating temperature of 25 degrees Celsius in full sunshine (irradiance) of 1 000 watts per square meter. This is a clear summer day with sun approximately overhead and the cells faced directly towards the sun. Unit: Watt (W), also wirtten Wp by professionals in the field.
- **Performance ratio**: Ratio of the final annual (monthly, daily) yield to the reference annual (monthly, daily) yield, where the reference annual (monthly, daily) yield is the theoretically annual (monthly, daily) available energy per kilowatt of installed power.
- **Photovoltaic array**: A mechanically integrated assembly of modules and panels together with support structure to form a d.c. power producing unit.
- **Photovoltaic cell**: A basic photovoltaic device, which generates electricity when, exposed to a light such as the solar radiation. All photovoltaic cells produce direct current (d.c.).
- **Photovoltaic module**: The smallest complete environmentally protected assembly of interconnected photovoltaic cells. For crystalline silicon cells, after testing and sorting to match the current and voltage, the cells are interconnected and encapsulated between a transparent front, usually glass, and a backing material. This 'module' is then typically mounted in an aluminium frame. Modules are normally rated between 50 and 200 W, although several manufacturers now offer modules above 200 W.
- **Photovoltaic panel**: A group of modules fastened together, pre-assembled and wired, designed to serve as an installable unit in a photovoltaic array.

- **Photovoltaic power system**: Set of interconnected elements such as photovoltaic modules, inverters that convert d.c. current of the modules into a.c. current, storage batteries and all installation and control components with a photovoltaic power capacity of 40 W or more. The typology is different according to application: see off-grid and grid-connected photovoltaic power systems.
- **Photovoltaics**: The process that produces electricity from sunlight. "Photo" refers to light and "voltaic" to voltage.
- **PV**: Abbreviation of photovoltaic (adjective) or photovoltaics (noun).
- **PVPS**: Abbreviation of photovoltaic power system(s).
- **Short circuit current (*I*sc)**: The current flowing freely from a photovoltaic cell or module through an external circuit that has no load or resistance; the maximum current possible. Unit: Ampere (A).
- **Stand-alone photovoltaic power system**: Autonomous system with storage batteries (see off-grid photovoltaic power system).
- **Standard test conditions (STC)**: The testing conditions to measure photovoltaic cells or modules nominal output power. Irradiance level is 1 000 W/m², with the reference air mass 1,5 solar spectral irradiance distribution and cell or module junction temperature of 25°C.
- **Turnkey price**: Price of an installed photovoltaic system excluding VAT/TVA/sales taxes, operation and maintenance costs but including installation costs. For an off-grid photovoltaic system, the prices associated with storage battery maintenance/replacement are excluded. If additional costs are incurred for reasons not directly related to the photovoltaic system, these are excluded. For example if extra costs are incurred fitting PV modules to a factory roof because special precautions are required to avoid disrupting production, these extra costs are not included. Equally the additional transport costs of installing a telecommunication systems in a remote area are not included.
- **watt (W)**: SI unit of power. Symbol is W. In this website it is understood power under standard test conditions (STC). Also written Wp (peak watt) by PV professionals to mean peak power at STC. Multiples like kW (one thousand watts = 1 000 W) or MW (one million watts = 1 000 000 W) are also used.

How to build a Solarium Porch and Solar Air Heater

Heating your cabin can be done in many ways. I use a combination of passive solar and propane heat. I also have a woodstove for backup heat but, because I live in the high desert, wood is scarce and buying it is expensive. You could use Natural Gas if lines run near your property or electric if you want to increase your solar panel system (not a good idea). There also heat pump and geothermal systems but these can be expensive and not available in some areas.

Passive solar is a simple and inexpensive way to supplement the heat in your cabin to reduce your energy consumption and provide healthy comfortable warmth. I have provided two passive solar plans here that can be used separately or together to bring heat into your cabin.

What is passive solar heat ?

Passive solar heat refers to a system to capture the heat that occurs when the suns rays strike an object without using a mechanical or electric system to aid it.

All of you have opened a car door when it has been sitting in the hot sun and felt the intense heat that has built up inside. This occurs when the suns rays penetrate through the windows and strike the objects like seats and dashboard creating heat. The heat is captured by the enclosed car and this is a passive solar heat collector.

This same principle can be put to use to provide heat to your cabin. In fact, if you follow the directions I gave you for building the cabin and direct your front windows towards the south you are already using passive solar to aid heating the cabin. The sun will penetrate through your south windows and strike objects inside the cabin releasing heat. My cabin warms up very quickly even on cold winter days as long as the sun shines. I turn my propane heater off at about 8:00 AM each morning and allow the sun to heat my cabin to a comfortable temperature. The propane heater goes back on about 6:00 PM when the sun and heat subsides. This saves money!

To increase the passive solar heat in your cabin there are two very easy to build projects that can reduce your heating bill. The first project is a solarium porch and the second is a simple to build solar air heater.

Solarium Porch

If you are building a porch on your cabin as I did it is a simple thing to enclose this porch to create a solarium that will add heat to the cabin. I do this in winter time and on sunny days I open the front door and allow the heat that has built up in the solarium porch to enter the cabin. When the sun goes down or heat subsides just close the door so the heat stays in the cabin. Don't be surprised if it overheats the cabin as a solarium porch can build up a lot of heat, but just close or adjust the door to regulate the heat entering the cabin.

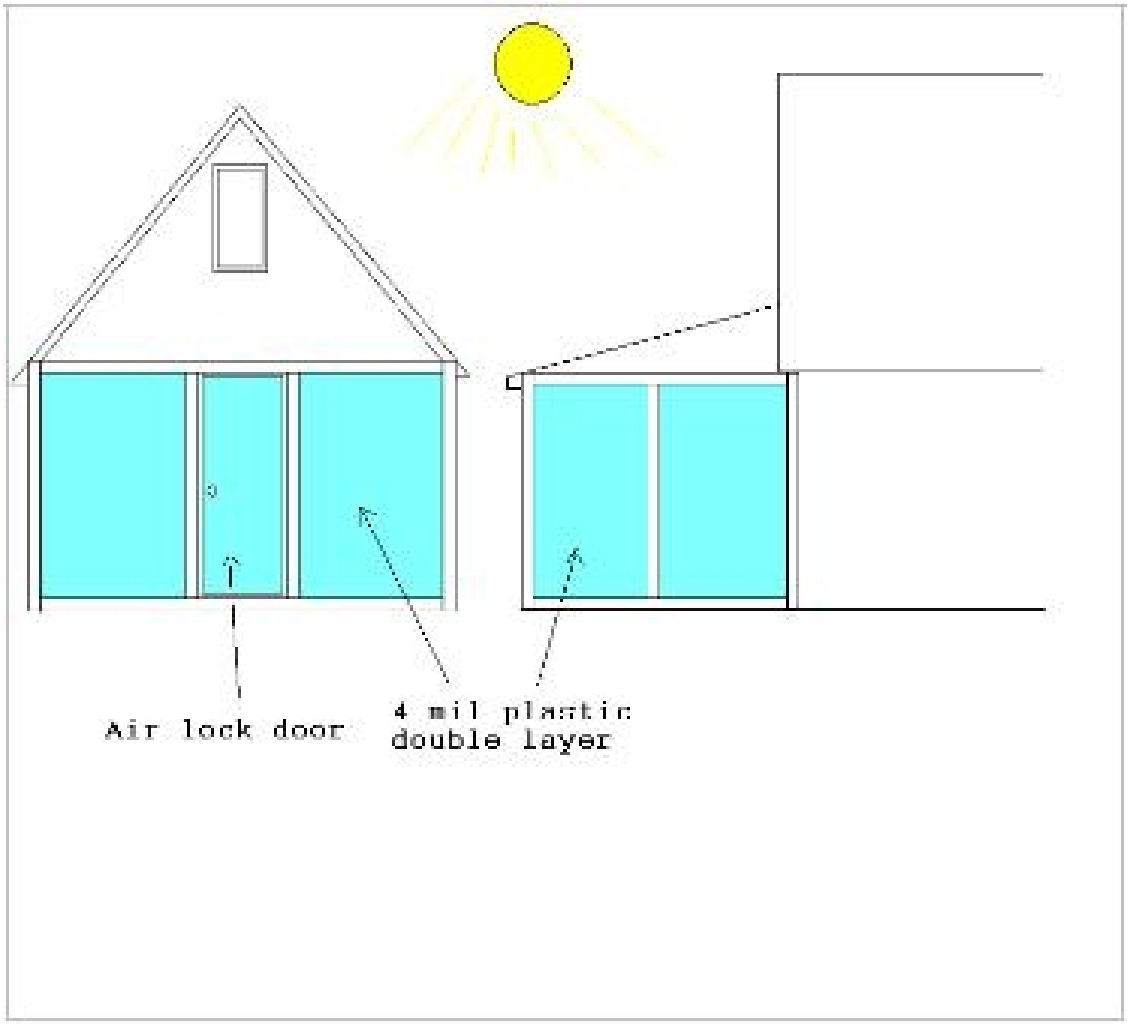
The solarium porch will also act as an airlock to your cabin. A tremendous amount of heat is lost when your cabin door is opened and this probably happens several times a day (or more with kids). The solarium porch has its own door and when you enter the porch and close the door it stops the draft that would normally enter the cabin and because the temperature in the solarium will be higher than the outside air less warm air will rush out of the cabin.

If your cabin already has a covered porch with support beams it can easily be enclosed with clear plastic. You will want to use heavy mil plastic and I use 4 mil. The plastic must be sealed tight and I use cardboard strips and staples to enclose my porch from top to the ground.

You will want to create a dead air space by putting one layer of plastic on the outside of the supports and one layer on the inside. The air space between is called dead air because it doesn't move and it creates an insulating barrier that will hold in more heat than a single layer of plastic. This same principle is used in designing double pane windows.

You can make a simple door or use a salvaged storm door for your airlock. I use a storm door and attach the hinges to a to a temporary 2x4 brace that attaches to my porch floor and ceiling. This allows me to remove and store the door when I take down my solarium in the summer.

You can also build a simple air lock doors from 2x2 lumber and enclose it on both sides to create dead air space in the door as you did the porch walls. A set of hinges (I used 3) will attach to a temporary 2x4 brace to finish the project.



The exact dimensions of your porch may vary but mine encloses the entire front of the cabin. This way I can open the front windows to let the heat in as well as the door. I can control the heat by closing the door or windows as needed.

I use my solarium from November through April and then take down the plastic and door and store it for next season.

For a more permanent solarium you could use double pane windows or if you dislike bugs you could enclose the porch in screen for summer and wrap the porch with plastic in winter.

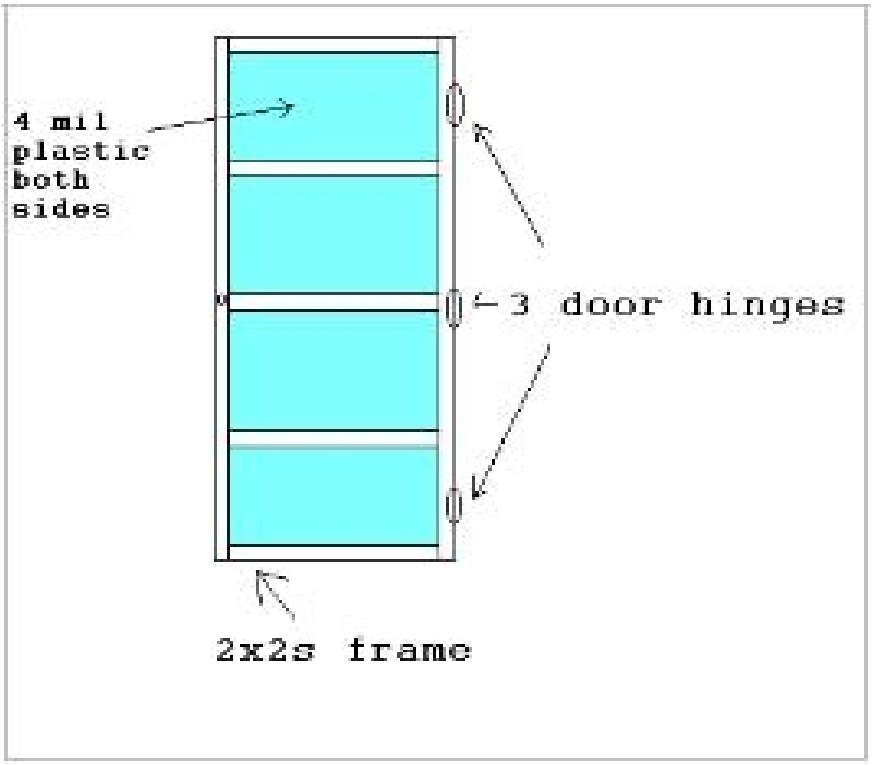
You do not need to put thermal mass (heat storing material) in the solarium and doing so may diminish the heat that will enter the house. Any objects that are on the porch will release the suns heat. Black metal objects will release a lot of heat and you can place these on the porch but be aware that they can reach very hot temperatures and burn a person or animal.

If your solarium gets too hot and you don't want the heat in the house just prop the solarium door open and it will cool down.

This solarium porch will add a lot of heat to your home, keep out drafts, and you will probably enjoy sitting out there on sunny winter days and feeling the suns heat. I spend many winter days on the solarium porch rocking, reading and playing guitar. It is also very nice to have a warm draft free porch to take off muddy boots and clothes before entering the house.

Your solarium porch can also be used in spring to start plants. It may still get too cold at night so you may need to bring in tender plants. The solarium is not meant to be a greenhouse and will not function well as one but can be used to get a head start on your spring gardening.

I use a salvaged storm door for my solarium but here is a simple design for building a solarium door from 2x2 lumber.



What is thermal mass ?

Thermal mass is any object (including people) that when struck by the suns rays give off heat. The thermal mass in your cabin will be the furniture, appliances, walls and floor.

Some materials are better at releasing heat than others. Water will absorb the suns rays quickly and release it quickly. To try this paint an old 2 liter pop bottle black, fill it with water and set it in the sun. It will get warm quickly and if you bring it in the house it will release its heat to the house quickly. This principle can be used to increase the heat in your house.

When you want extra heat in your cabin in winter you should open the curtains or blinds on the south side of your cabin and let the sun warm the thermal mass. Close the curtains or blinds when the sun is no longer shining through the windows. Just doing this will greatly increase daytime heat in the cabin. On the other hand, windows on the north side of your cabin (and east and west if they do not get direct sun) should be covered with an insulated curtain to keep heat in the cabin in winter.

I use window quilts on my north windows which is just blanket material enclosing a layer of quilt batting. Fit the window quilt snugly around the window frame to create dead air space between the quilt and window.

On southern facing windows attach the quilts with Velcro or snaps to the window frame so you can still open the window quilts and let the sunshine in on sunny winter days.

You may want to increase thermal mass in your cabin to increase heat. This can be done by filling 2 liter bottles painted black with water and placing them in south facing window sills. When the sun strikes the bottles they will warm and when the sun stops shining they will release their heat.

If you have a wood stoves these bottles or cans of water can be placed near the stove to absorb the stove heat and will release it when the fire dies down. You can also add thermal mass behind the stove by applying brick or rock to the wall surface.

If you really want to increase thermal mass in your cabin you could add an extra sheet of drywall to the walls that get direct sunlight through windows or nearest the wood or propane stove. Putting extra thermal mass where sun light or furnace heat does not warm the surface will not increase cabin heat and may decrease the heat in your cabin!

Solar Air Heater

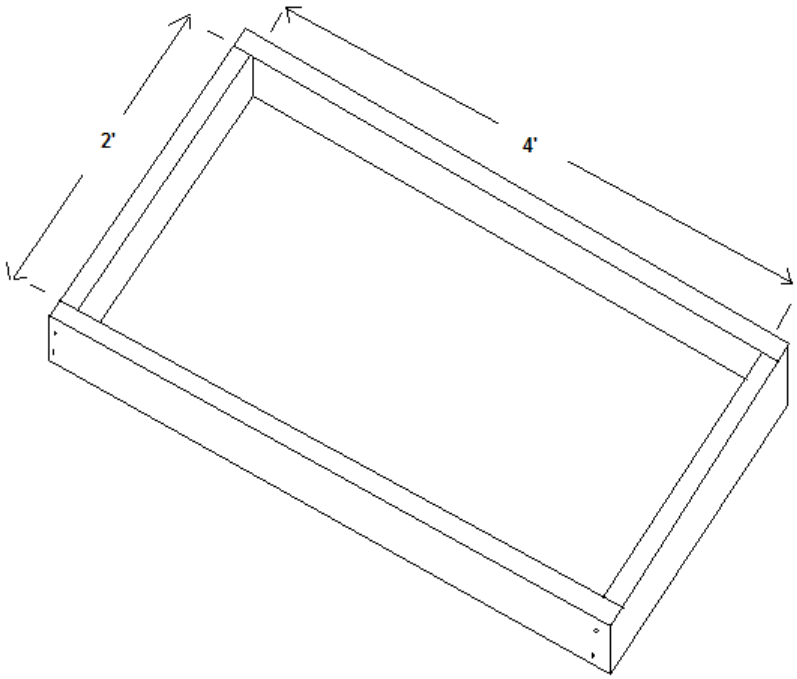
You can build a simple solar air heater that can be attached permanently or temporarily to the cabin. These heaters are excellent for warming small areas and one or two of these on a small cabin will really increase heat on sunny winter days.

The solar air heater works by collecting the heat produced when the sun strikes a black metal sheet under glass. The heat moves through the heater by solar air current as cool air enters one end of the heater and pushes the warm air out the other end and into the cabin.

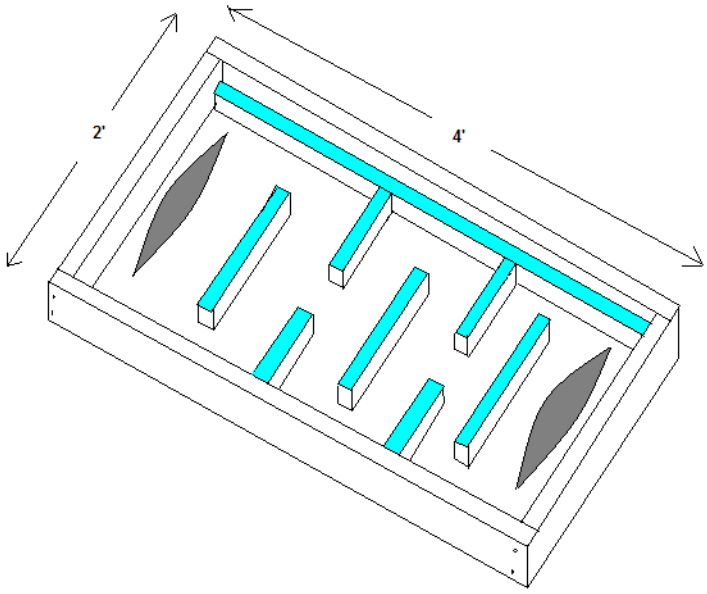
This same solar air heater plan is used to heat the solar food dehydrator in another chapter.

Materials: You will need two 2x4x8, one 4x8 wafer or plywood sheet, one 2x4 metal corrugated roof panel, one 1x2x8, flat black spray paint, handful of 1 inch wood screws, tube of caulk, small length of flexible vent duct, and either a 2x4 piece of clear glass or clear plastic. You may have most of these materials sitting around but even purchased new you can get it all for under $50. Glass works best and most window shops have old storm windows they sell or give away if you ask around.

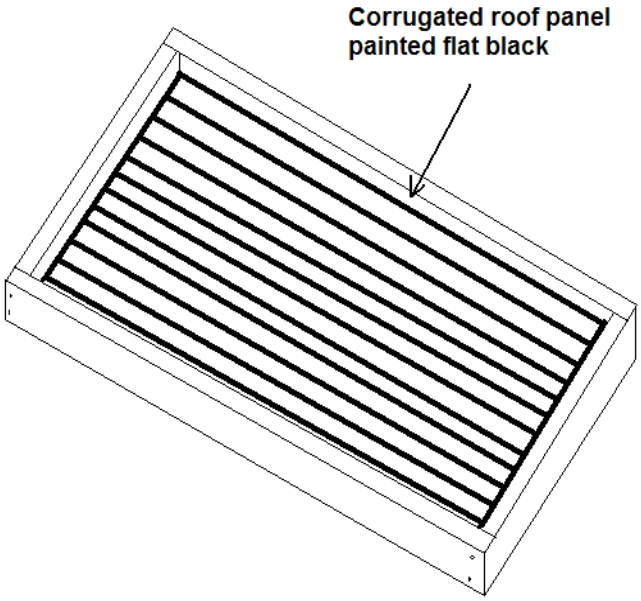
Step #1: build your box out of 2x4s as shown using wood screw. Note the inside dimensions must be 2x4 or fit your corrugated panel. The size of the solar air heater can be adjusted to your window size but I have used the dimensions to fit a standard 2 x 3 window which is what is in my cabin.



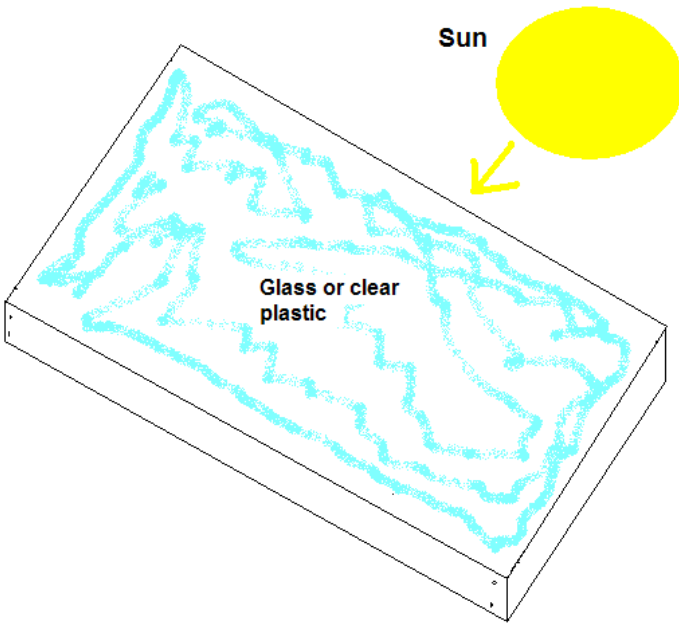
Build the heater box out of one 2x4x8, Attach corners with screws.
Attach a piece of plywood to the back of box with screws and glue.



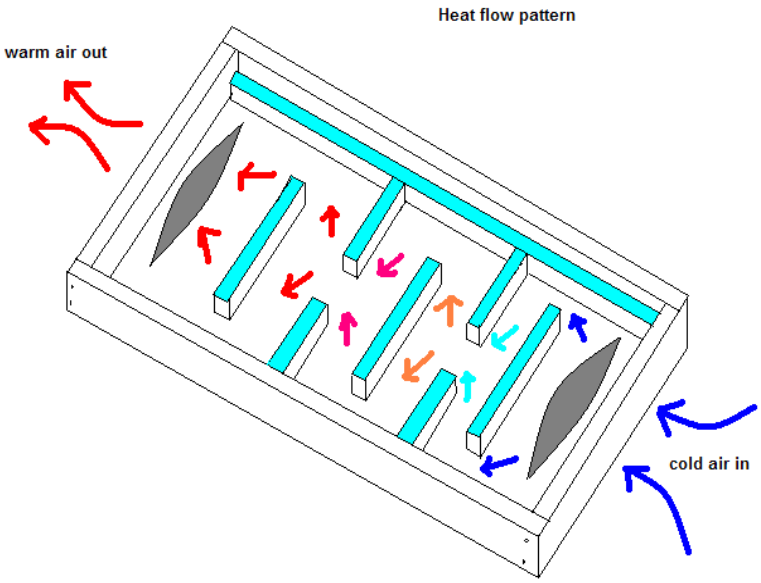
Step #2:
Heater braces are made from 1x2 lumber. Vent holes are cut in the back of the heater at each end. Attach the 1x2 braces as shown with screws.



Step #3:
Attach the 2x4 black painted corrugated roof panel to the braces and seal around the edges with silicon to make it air tight.



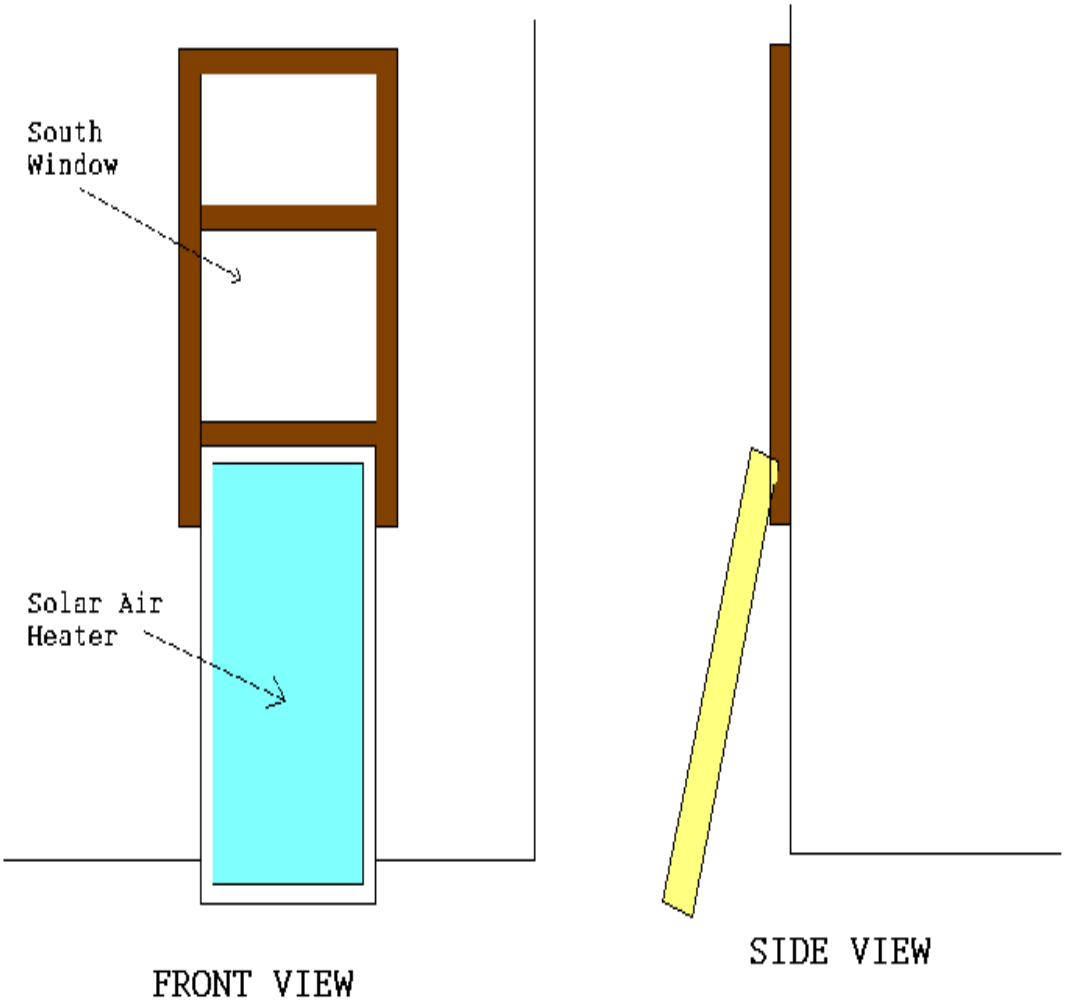
Step #4:
Attach a sheet of clear glass to the front of the box and seal edges with silicon. An old storm window would work or two layers of clear plastic will work if you do not have glass available. Window and door shops often have salvaged windows or a pane of glass you can get for free or low cost. Glass would work best.



How it works

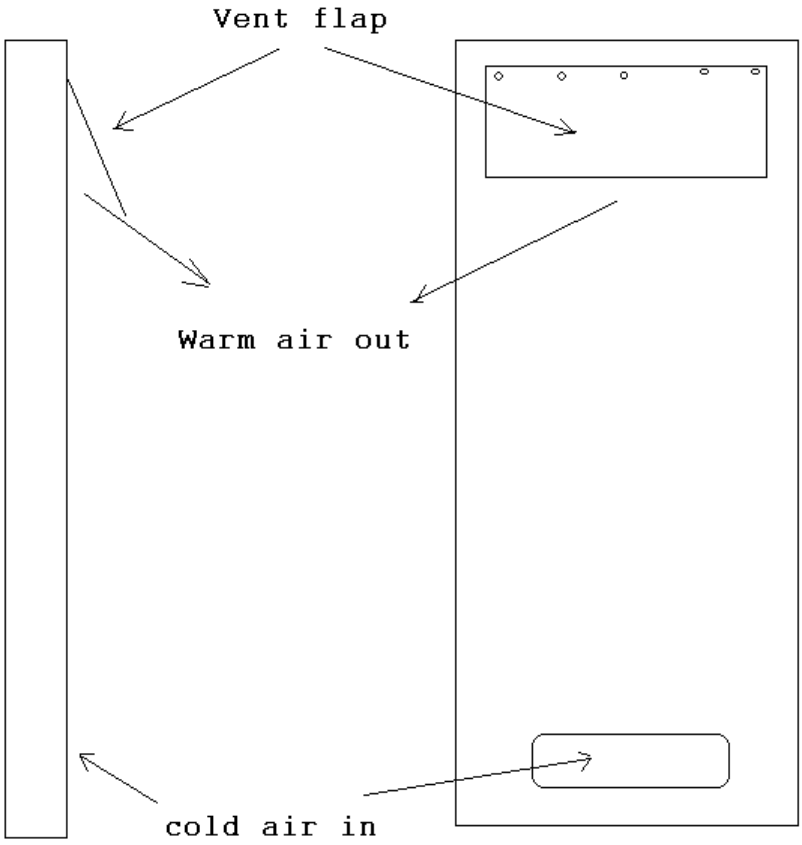
When the sun shines through the glass it will heat the metal sheet and the heated air behind the metal sheet will be replaced by cool air entering the bottom vent. This is called a thermal siphon and as long as the solar air heater is receiving sunlight the cool air will push the warm air through the heater and out the top vent. The warmer the air gets in the heater the faster the air will move.
Attaching the solar air heater

You can attach the solar air heater as a permanent heater or as a temporary heater.



The heater can be placed with the top vent opening in a south facing window. Close the window so only the vent is showing. Insulate around the vent to keep heat from escaping through the window.

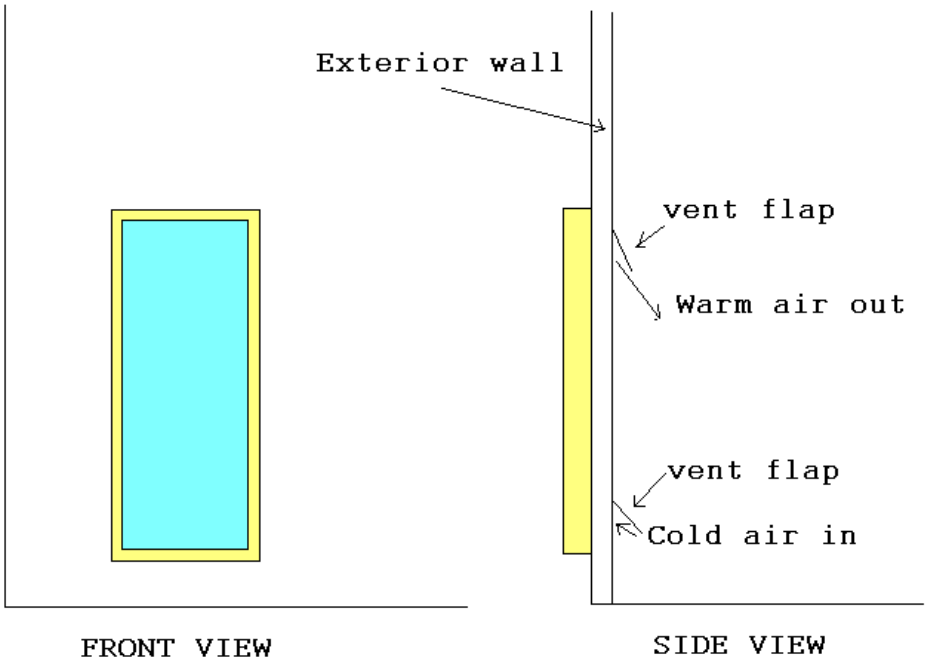
The solar air heater will pull in cold outside air and heat it as it enters the house through the window. When the sun goes down you will need to block the vent or the heater will work in reverse and pull warm air back out of the house. You can attach a sheet of thin flexible plastic to the outside of the top vent that will only allow air to come in and keep warm air from going out as seen here.



The solar air heater will only work in direct sunlight but can be used in any south facing window. The window should fit snug against the heater and you must insulate around the heater vent or you will lose precious heat from the house. The temporary heater works well if you just want to use it in winter and store it away in summer.

Permanent mount solar air heater

If you want to mount the solar air heater permanently you will need to cut holes through your cabin wall. Find your wall studs and make an opening just big enough to cover the vent openings. Be aware and avoid cutting any wiring or plumbing that may be inside wall and do not cut through any wall studs or wall bracing.



You will need vent flaps on both in vent and out vent to prevent room heat from being drawn out of the house. Open the vents only on sunny days and close them at night or when sun isn't shining. You can buy closing vents at any hardware store for this purpose or make your own. The permanent heater will work all year long so you will want to close the vents when extra heat is no longer wanted. You could build several solar air heaters and place them on any south facing wall to increase heat production.

Both the solarium porch and solar air heaters work great to add extra heat to your cabin. I use the solarium porch on my cabin because I like to sit on that warm porch on cold winter days and I have permanent solar air heaters on my workshop so I can work comfortably on sunny winter days. Solarium porches are also a great way to dry wet clothes in the winter. I hang my wet clothes on a line in my solarium and they dry almost as fast as using a conventional dryer and they have never frozen.

These passive solar heaters will only work in direct sunlight and will not add any heat at night. If the vents are left open when the sun is not shining they will work in reverse and pull heat out of the house. These solar heaters are designed to assist heating your cabin on sunny days and can reduce your heating bill significantly.

Solar Methane Generator

Disclaimer and Warning:

The following plans are for a home use methane biomass digester that is experimental. The Author will not be responsible for any damage or harm that results directly or indirectly from the construction, use, or misuse of these plans. Methane is a highly flammable and explosive gas and its use or misuse could result in damage, injury and death. Home fuel production may be regulated by law and it is the duty of anyone producing fuel to know and follow all local, state and federal fuel production laws.

What is methane ?

Methane is a naturally occurring gas that forms when micro-bacteria digest plant cellulose. It has also been called swamp gas or bio-gas. It has been used as a fuel source in far eastern countries for many hundreds of years. It burns clean, has a lot of BTUs and can be used for fuel for cooking, lighting a home, heating, powering gas fueled refrigerators, coolers, generators and even fueling a vehicle.

When produced an-aerobically (without air) methane has very little smell. It is a clean fuel very similar to propane and Natural Gas.

Methane can be created simply and cheaply and can be used in small appliances like propane cook stoves and lanterns without changing the appliance and can be used in Natural Gas appliances or used in a converted vehicle as fuel.

History of Methane use

The first recorded incidence of methane fuel came by accident when people in Europe were shocked by explosions caused when lightning ignited the gas coming from local swamps but it was the Chinese people that figured out that this gas could be created from storing manure and plant waste in a container and siphoning off the gas to be burned in lamps and for cooking.

During World War II vast numbers of automotive engines were adapted to run on methane and it is still entirely possible and practical to fuel tractors, vehicles, generators and other engines in this manner.

Large scale Methane production is now being used around the world for fuel production. Cattle dairies, chicken and turkey farms in the U.S. have quickly recognized the value of methane and many fuel their entire production facility and even sell off excess methane for a profit.

Examples of small methane production

Small batch methane digester courtesy of L. John Fry

Small scale sump digesters courtesy L. John Fry
Note: Methane gas has pushed smaller barrels up

Examples of large scale methane production

Covered lagoon digester, Wisconsin

Complete mix digester, Colorado

Why make Methane ?

If you have a ready source of manure and plant material the question should be why not produce methane ?

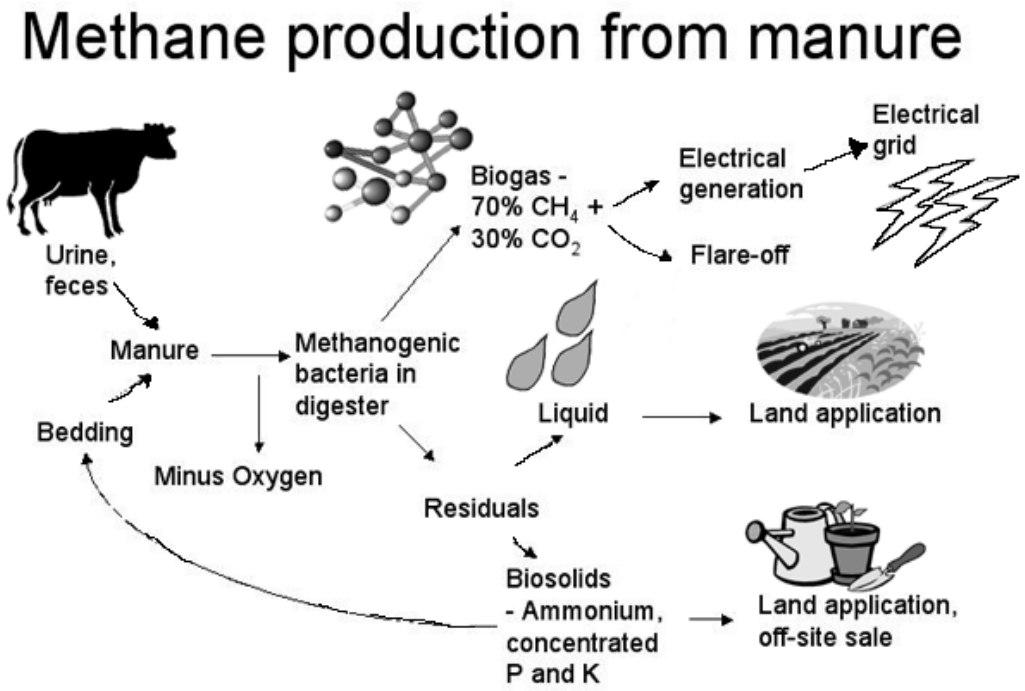
These waste products contain a huge amount of carbon locked fuel that if disposed of in a landfill or put into soil will be digested by micro-bacteria and the methane will be released into the environment. This methane is considered a toxic waste and greenhouse gas and has been proven to be a contributor to Global Warming.

By capturing the methane you will be reducing the methane released into the environment and producing a fuel that will reduce your need to buy expensive petroleum based fuels that when burned also release CO2 which is also a greenhouse gas that contributes to Global Warming.

You will also be providing cheap fuel source that is very versatile. If you have a ready source of manure and plant material your cost to produce methane could actually be free.

PLUS- the plant waste and manure that has been digested by micro-bacteria is excellent for use as fertilizer on gardens, flowers, and fields. There is no harmful bi-product.

Who wouldn't want a free source of clean energy that reduces the damage we are doing to our environment!



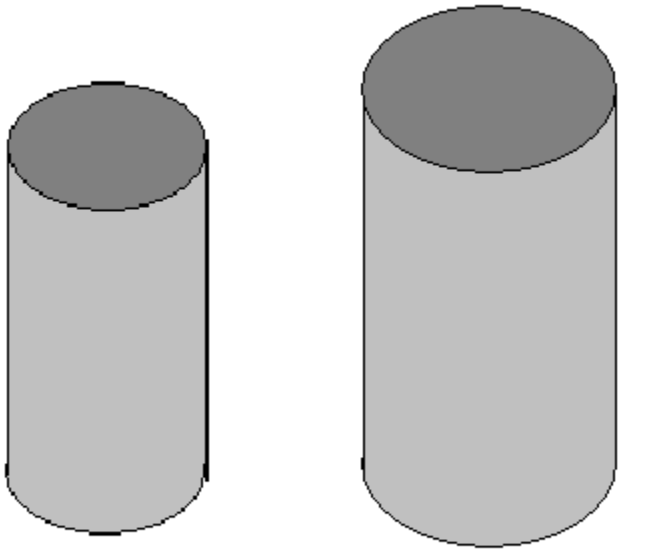
How to build a batch methane digester

These plans are for a stand alone small batch methane digester. You can easily increase capacity and production by making several of these and linking them together. By staggering the load of the digesters you can produce a steady supply of methane fuel.

What you need:

Step 1: Get your barrels

You will need two steel barrels. One smaller and one larger. A 35 gallon barrel and a 55 gallon barrel work very well. The smaller barrel should just fit inside the larger barrel with enough room to move up and down freely.



35 GALLON BARREL 55 GALLON BARREL

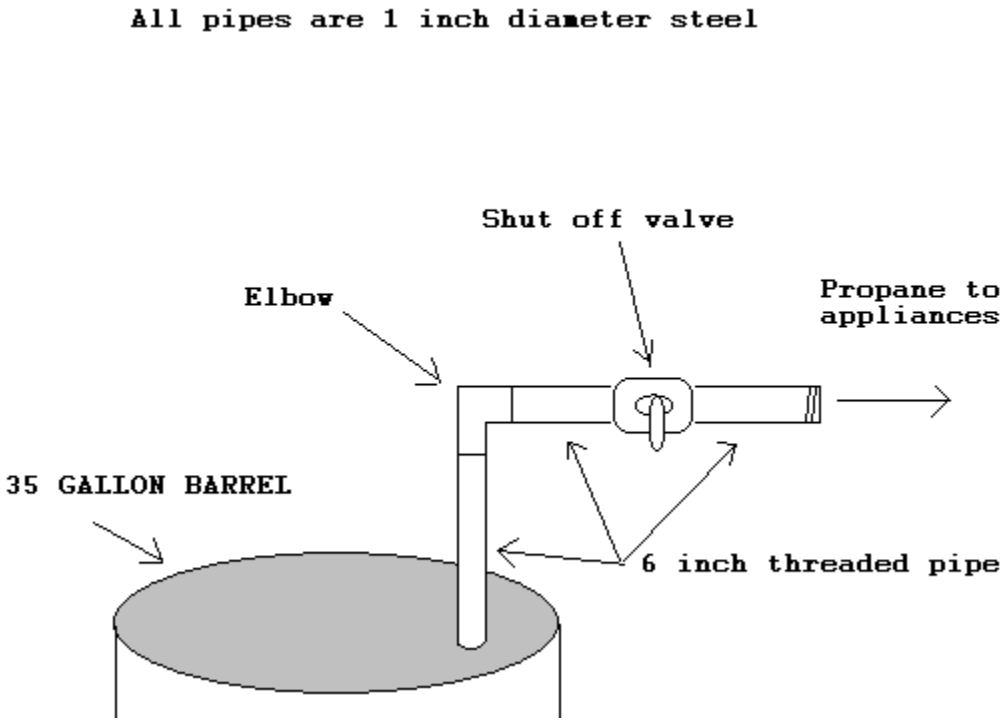
NOTE: we do not recommend plastic barrels as there is a possibility of static electricity building up and causing the methane to ignite and explode. The barrels MUST be grounded as shown in step 4. The barrels must be in good shape without holes or serious rust

Step 2: prepare the barrels

Carefully remove one end of each barrel. If the smaller barrel has bung openings you should remove the other end and this way you can use these bung openings to install your pipe fittings. Some barrels have removable tops or you can drill and cut through the top with tools. Be careful of sharp edges!

Step 3: Install the fittings

On the uncut end of the smaller barrel you will install the following pipe fittings.

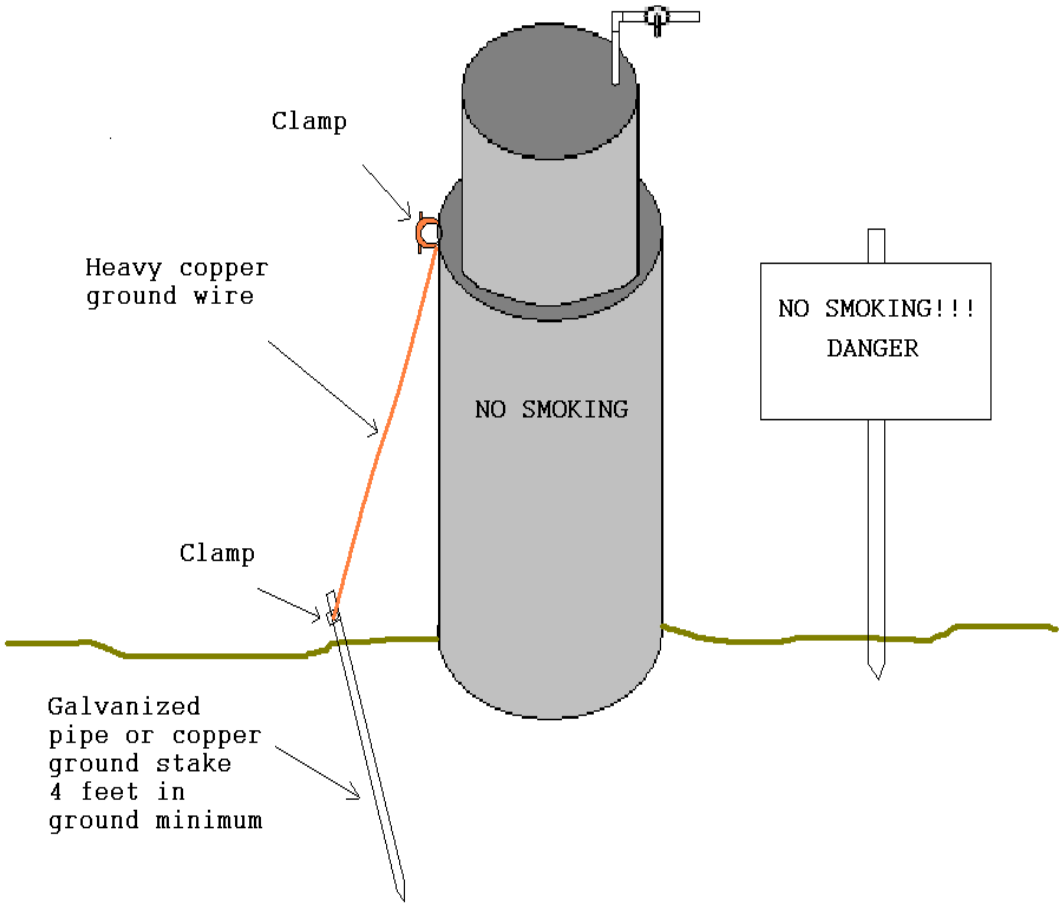


Note: pipe lengths are just a suggestion and diameter of pipe could be larger or smaller to fit your appliance orifice.

Step 4: Ground the barrels

Methane is flammable and explosive. Even a small static charge or nearby lightning could ignite the fuel so barrels must be grounded. Use a 4 foot piece of galvanized pipe, heavy duty copper ground wire, and 2 clamps to secure the ground to each barrel as shown.

Completed Batch digester



Note: place digester on level ground away from house and structures. Post no smoking signs and danger signs to alert people to danger.

DO NOT ALLOW OPEN FLAMES NEAR DIGESTER!!!

How it works

What are micro-bacteria ?

Micro-bacteria or microbes are microscopic organisms that eat manure and plant material causing decomposition and releasing methane gas in the process. These micro-organisms are present in most soil where plants are present. They are also present in sewer sludge and decomposing waste. They are very lively under the right conditions and if given a steady supply of food material they work continuously.

Starter Brew

In order to produce methane your digester needs to be started with a brew of already active microbes. There are a few ways to do this.

If you have an active compost pile that is rapidly decomposing then the microbes can be gathered from that source. Dig deep into the pile and collect the dark rich decomposed material.

If you have or live near a dairy or pig farm you can collect these bacteria from the decomposing waste. Do not collect fresh manure. You want the deep dark manure from a pile that has been actively decomposing for a while.

If you live near an orchard or trees that produce a lot of leaves you can collect the bacteria in the soil and decomposing leaves under the trees. Dig under the leaves and get the dark rich soil and decomposing material that makes up the top soil.

You will need at least a gallon of this starter brew. The dark warm decomposing material you collect will hopefully be full of microbes that when added to your digester will quickly go to work eating and creating methane.

It is VERY important that you leave enough starter brew in your digester to keep the microbes alive and thriving. If you empty the digester only remove about 5 gallons at a time and replace with fresh manure, water, garbage, and plant material to feed the existing micro-organisms.

Loading the digester

The 55 gallon barrel is loaded with a slurry mix of water, fresh manure and dead plant material like grass clippings, corn stalks, vines, leaves, sawdust etc. It is started with starter brew.

Mix

Add 1 gallon or more of your starter brew
Ten gallons of water
Two 5 gallon buckets of wet manure
Add enough plant material to fill drum about 2/3rds full
*** the mixture should be the consistency of cream**

Slide the 35 gallon barrel open end down into the 55 gallon barrel.

Open the shut off valve and push the 35 gallon barrel down to expel any trapped air. You will hear air coming from the outlet pipe and see escaping air as bubbles around the barrel. Expel all trapped air. Close the shut-off valve completely.

NOTE: Methane when mixed with air is very flammable and explosive. You MUST completely expel the air in the 35 gallon barrel.

Detention Period

This is the amount of time it will take the micro-bacteria to begin producing methane. For a 55 gallon system this will usually be about a week.

Expel the first methane produced.

In about a week or sooner you will see the 35 gallon barrel begin to rise and float inside the 55 gallon barrel. This is the methane pushing up the barrel.

Because there could still be air trapped in the 35 gallon barrel you must open the shut-off valve and push the barrel down to expel this first mixture of air and methane. The air and methane will be seen as bubbles around the barrel. You only need to do this once as the barrel begins to fill with methane. This first methane will not burn well anyway because of air in the mixture.

Using your methane

When the 35 gallon barrel has raised and you have completely expelled the air your methane is ready to use.

You will need a connection for your appliances. You can buy propane and NG rated connectors and hose to match your propane or NG appliance or make your own or have a propane installer make them for you. Propane and NG appliances must have a regulator installed before using methane.

Connect the propane or NG hose to the outlet pipe on the digester.

Connect the other end to your propane or NG appliance with a regulator installed.

Open the shut-off valve on the 35 gallon barrel

Open the turn-on valve on your appliance and light the fuel as you would for propane or NG.

You may notice a slight smell and this is normal with methane. It is also useful in helping find methane leaks in hoses and connections.

NOTE: larger propane appliances like stoves, refrigerators, etc. may not work without converting to NG orifices but NG appliances usually work very well. Small propane appliances like barbecues, grills, and lamps will usually work just fine.

How much methane will I produce ?

The digester will continuously produce methane until the micro-bacteria run out of food which is usually about 3 weeks if not reloaded. Generally a one barrel digester will produce enough methane to run a stove for about a half hour each day or a trio of propane lamps continuously.

To increase methane production you can build more individual unit's and link them together. By staggering load dates you can have an uninterrupted supply of free methane.

Reloading the digester

You can add more slurry mix as the digester is operating. Remember to expel the trapped air when replacing the 35 gallon barrel.

When the methane production slows or stops remove the appliance hose, open the shut-off valve to bleed any residual methane and remove the 35 gallon barrel.

Remove 5 gallons of the composted slurry and replace it with 5 gallons of fresh manure, plant mater, and water to the consistency of cream.

The slurry mix that is emptied is now excellent fertilizer for gardens, fruit trees, house plants, and pastures. Just take a scoop as needed and add it to the soil to increase nitrogen.

Stir the digester slurry to move new material deeper into the barrel for better decomposition. An old wood boat paddle works great for this. Replace the 35 gallon barrel and completely expel the trapped air. All trapped air MUST be expelled or an explosion can occur!

Manure recipe for slurry

Not all manure is equal and some will produce more methane than others.

Gas Produced By Total Solids of Wastes

Manure	Ft3/lb of Dry Matte(TS)
Pig	6.0 - 8.0
Cow	3.1 - 4.7
Chicken	6.0 - 13.2
Conventional Sewage	6.0 - 9.0

You can use human manure for methane production if you have a composting toilet (see building a solar composting toilet) however, because of the possibility of disease contamination it is not recommended that you use the leftover slurry on gardens but it could be used on flower beds and around fruit trees. Human manure from a conventional septic system should not be used for methane production because of other harmful chemicals that could kill the micro-bacteria.

Never add chemicals, pesticide sprayed plants, or anything that might kill the micro-bacteria. If the slurry is not producing methane this is usually the problem. Empty the barrel, flush it out and start again with fresh water, manure, plant waste and starter brew.

Kitchen food waste and garbage can be used in a digester but avoid putting in meat waste or anything that will be slow to decompose or kill the micro-organisms. Shred the material before digesting if possible. Kitchen wastes may cause bad odors and stinky methane!

Eventually metal barrels will rust through. Be prepared with extra barrels. You can spray the inside of clean barrels with automotive rust resistant paint to extend barrel life.

Check your pipe fittings frequently. Even a pin size leak will greatly reduce the methane production. Retighten pipe joints as needed.

Monitor the barrel frequently. Methane production can be fickle and an empty barrel can fill quickly. If the 35 gallon barrel overfills it will release the valuable methane. This is a safety feature to keep barrels from overfilling and rupturing. If you will not be using the methane digester remove the appliance connection and open the shut-off valve to release the methane safely.

Build a Methane Generator

Now that you have a solar methane digester there is no reason you can't put that methane to use as fuel for an electricity generator.

If you already have a propane or Natural Gas generator just connect the methane connecter from the digesters to your generator and it should run fine. You may need to adjust fuel mix with the choke control as is normal.

If you have a gasoline fueled generator you will need to adapt the fuel system to run on propane and methane. The easiest way to do this is with one of the factory produced kits. You remove a fuel hose and follow directions on the kit for installation.

You can get these kits for just about any generator under 12 hp for under $200.

Here is the kit and company I used to convert my 1500 watt gasoline generator to propane. The kit was inexpensive, directions were understandable, and installation easy.

Kit from: US Carburetor Inc.
www.propane-generators.com

Once your solar methane digesters are producing continuous methane you will get a couple hours of run time each day. I have a six barrel system and I can run my 1500 watt generator for 3 hours everyday which runs my power tools, washer and dryer, and other large appliances. That would cost me about $4 a day or $120 a month using gasoline but costs nothing using my solar methane!

Storing methane

Your sump methane digester is designed to be used continuously and will produce methane as long as the micro-organisms are active. If you plan to only use the methane sporadically you may want to collect and store the methane for later use.

An easy way to do this is with truck tire rubber inner-tubes. You will need to fashion a hose connector to attach the tube to the digester outlet. A screw on tire inflation hose can be connected to the digester outlet for this purpose.

You MUST expel the air in the tube before attaching to the digester. Remove the tube air core and squeeze out all air and replace the air core before attaching to the digester. The air core will keep the methane in the tube but put on the plastic inner-tube cap for extra safety.

Attach the inner-tube and connector to the digester. Open the shut-off valve and leave the inner-tube connected to the digester outlet until the tube is ¾ full. Close the shut-off valve and remove methane tube and cap it for storage and attach another tube to the digester for more storage.

WARNING! These inner-tubes are full of methane which is flammable and explosive. Store them away from house and structures and clearly mark each tube DANGER - NO SMOKING!

Using methane storage tubes

When you need methane you can connect the tubes to the appliance or connect it to the inlet hose that goes from the digester to the appliances. This is handy for keeping appliances fueled when refilling the digester.

These tubes will expand with methane creating a low pressure flow that can be used like small propane tanks and are excellent for fueling camp site appliances like cook stoves and barbecues.

WARNING! Do not attempt to pressurize a propane tank or other storage container with methane. This requires special equipment and is not recommended for layperson use.

My methane story

I built my first methane batch digester 3 years ago as an experiment using the exact same plans described here. I had a couple of old drums just being used for burn barrels and the pipe fittings were salvaged off a discarded water heater. It cost me nothing to build.

I loaded it with chicken manure, grass clippings and water. I expelled the first methane to remove trapped air at about 4 days. By day 12 the 35 gallon barrel had rose almost out of the barrel so I figured it was ready.

I attached my propane barbecue to the outlet pipe and cracked the shut-off valve. The barbecue lit right up and we had steaks for dinner!

How to build
a solar batch water heater
for under $50

WHAT IS A BATCH HEATER ?

A batch heater as its name implies only heats a quantity of water to be used and then the water is replaced as needed. I only need a few gallons of hot water at any time to be used for washing dishes or taking a shower so a batch heater works better for me than one of those complicated roof top panels.

HOW DOES IT WORK ?
A batch heater is simply an insulated box covered by glass or clear plastic that holds a container of water to be heated by the sun. When the sun shines through the glass its heat is absorbed by the water and you have hot water within a few hours in direct sunlight, even in winter!

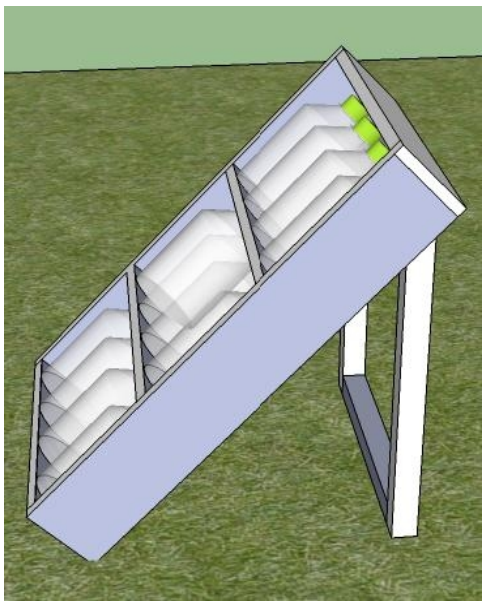
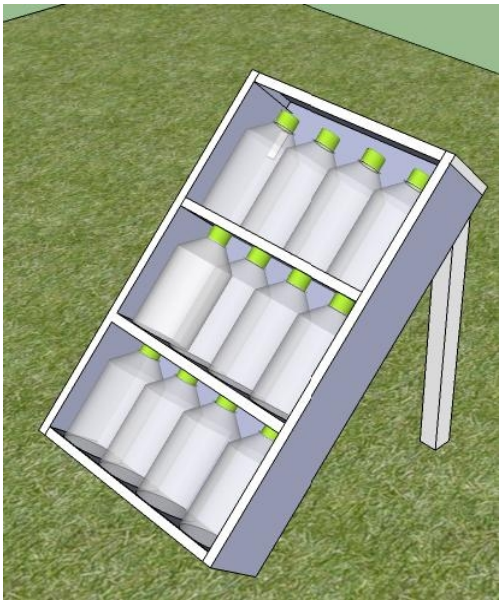
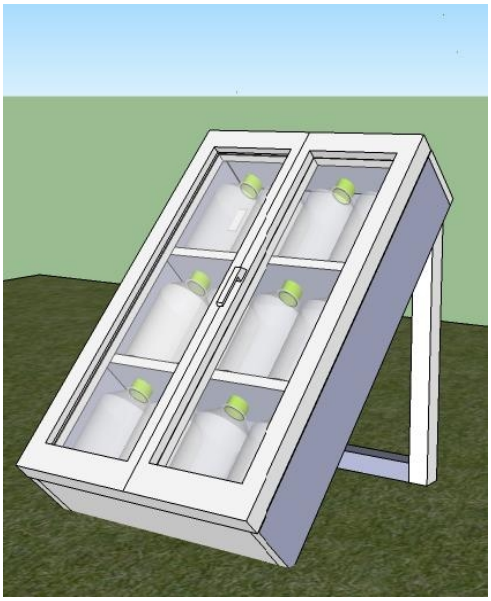
HOW IS IT BUILT ?

I will give you directions for a small one use batch heater and a larger batch tank heater.

Small use batch heater

Step #1: build an insulated box

I used cedar fence boards for my batch heater. Screwed together with deck screws and insulated with left over Styrofoam from a packing crate. A good size is 2 feet by 3 feet. Line the inside of the box with aluminum foil to reflect the suns rays at the water containers.

Step #2: cover the box with glass or clear plastic

I had a couple of old single pane windows sitting around so I used those. I mounted them to the box with a couple of hinges so I could open and close the box easily. You could make a simple frame out of 2x2s covered in clear plastic if you don't have a window to use.

Step #3: Put in your water containers. I built the box big enough to hold six 2 liter bottles so I have enough for two days before refilling. I use 2 liter plastic soda bottles and I spray paint the back side black to help absorb the heat. Any clean glass or plastic bottle should work.

Step #4: Put the batch heater in the sun

I place the batch heater on a bench angled into the direct sunlight and within 3 hours the water is hot enough (sometimes too hot) to wash dishes or take a shower with. I can take out 1 or 2 bottles at a time and use and refill them quickly. The water will stay warm until late evening and may freeze in winter nights but the sun will thaw and heat it right back up the next day. Well that's all there is to it!

I like the convenience of grabbing a hot bottle of water to put in my dishpans and because I use only 2 gallons of water to shower in I can mix my hot water into my cold water to get just the right temperature. This system works especially well for small use and I don't have to worry about pipes freezing and bursting as happens with big systems.

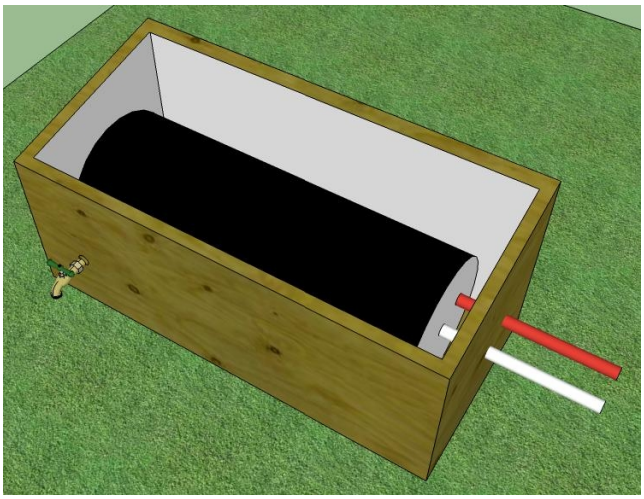
Here's a simple picture to show you my design:

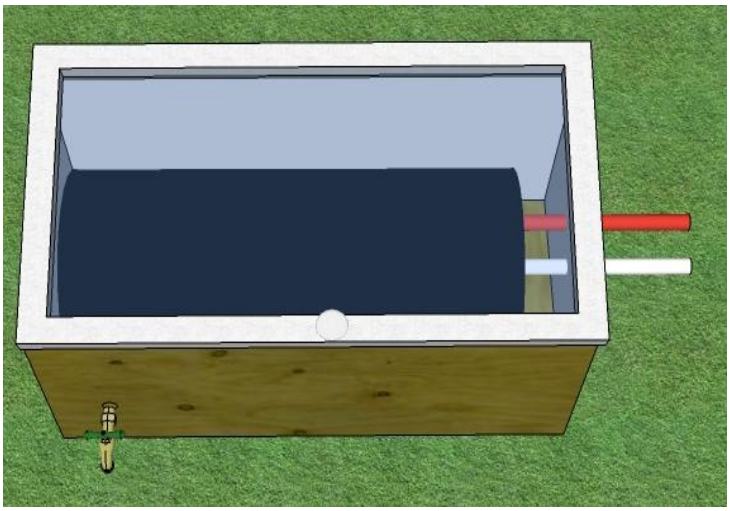
WARNING! The water in these containers can reach scalding temperatures so handle with care and do not allow children to handle or open containers.

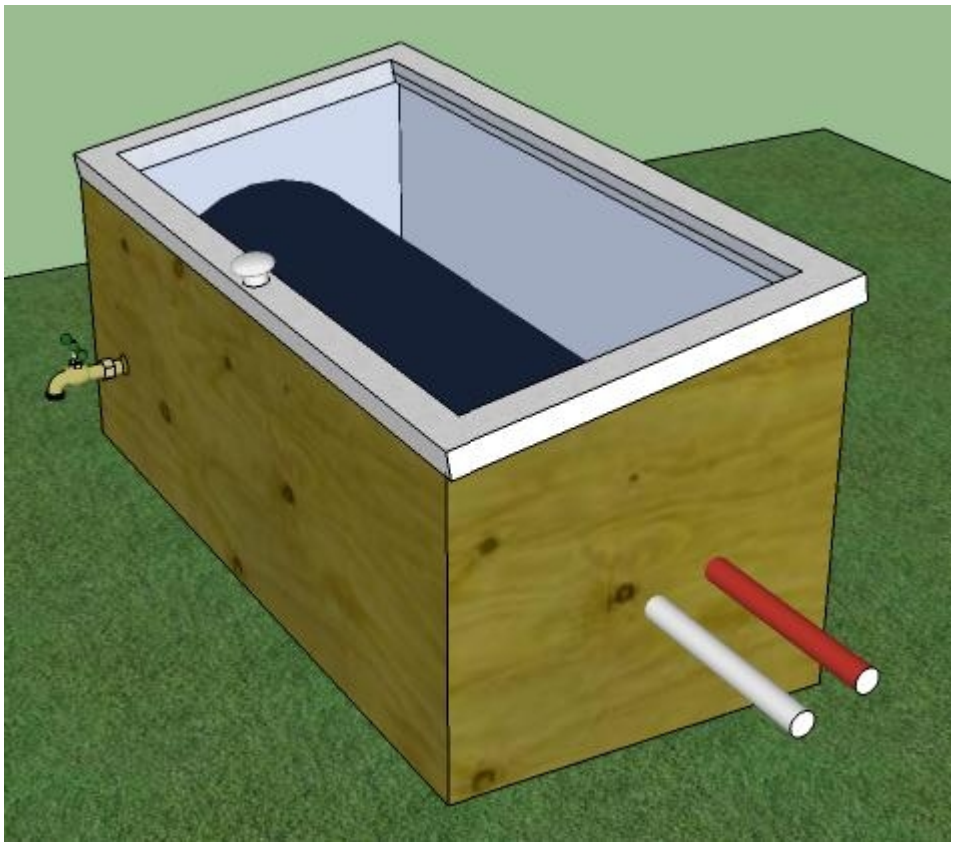
Large Batch Water Heater

Step #1: get a metal tank- old water heater tanks work great as long as they do not leak. Empty out any hard water deposits and replace the anodes if gone or to badly deteriorated. Spray paint the tank flat black to absorb heat.

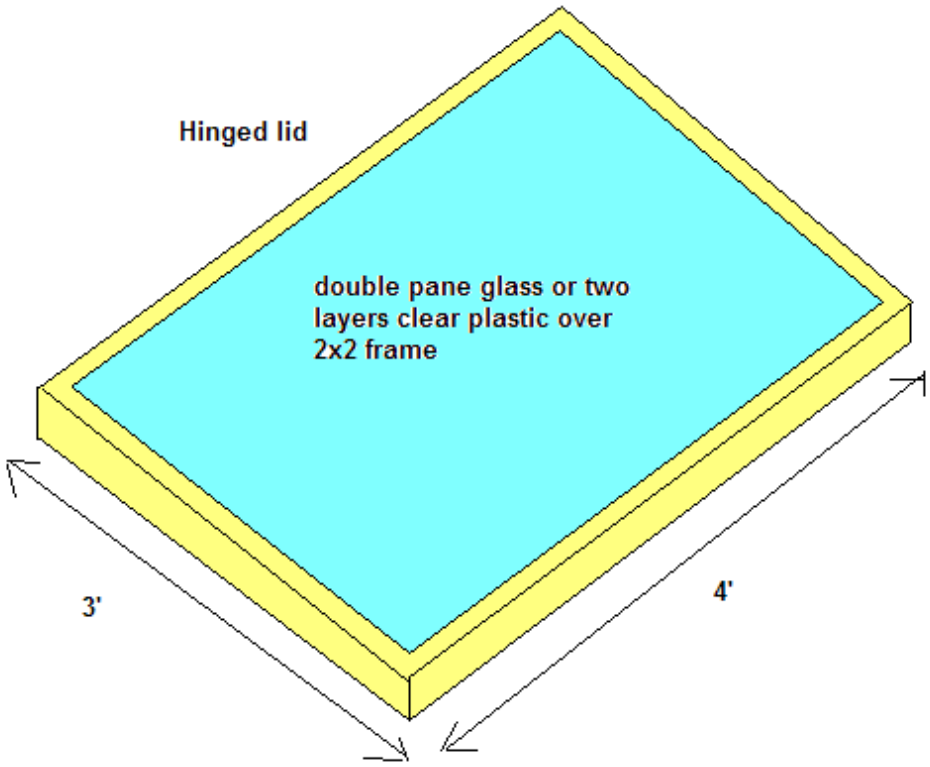
Step # 2: Build an insulated box. The dimensions will vary with the size of tank you are using. Use Styrofoam, polystyrene or batt insulation, old carpet pad, or cork board and insulate all walls and the bottom of the box. Cover the insulation with aluminum foil shiny side out to focus the suns rays onto the tank.







Step #3: Build the lid. I used 2x2s and an old double pane window but you could use two layers of clear plastic wrapped around the frame and stapled in place.



Step #4:Install your tank in the box with one outlet higher than the other. The upper outlet will be the hot water outlet and the lower will be the cold water inlet. I used pex pipe for my inlet and outlet because its flexible but you could use any metal pipe just remember to insulate both pipes to prevent freezing and heat loss.

Step #5: Hook it into your water system. I use a 12 volt dc pump that pumps cold water into the tank when it senses the water being drawn out through a tap. Insulate both inlet and outlet pipes to prevent freezing and heat loss.

HOW IT WORKS: Place the box and tank so it gets full southern exposure and within 4 to 6 hours the tank water should be warm or hot. When you turn on your hot water tap the pump will push cold water in to the tank and hot water out to the tap. This tank usually will not freeze overnight even in winter unless you get 2 or 3 days without any sunshine but pipes are more vulnerable to freezing. If using this batch heater in winter I suggest covering it at night with thermal blanket to prevent heat loss. Many people use these for seasonal use and drain the tank in winter.

Caution! This water may be scalding hot so be careful and monitor children. Cover the box with an insulating blanket on cold nights to hold the heat inside.

Batch Water Heater Video

SOLAR BATCH WATER HEATER "PART ONE"
by BACKYARDSOLAR
24,316 views

http://www.youtube.com/watch?v=C2Xe_glVoqc

Other Water Heater Ideas

Evacuated Tube Rooftop Solar Water Heater
Click pictures for more Information

Solar Camp Shower

Propane Camp Shower

Propane Pump Shower

Summary

For my first year living off-grid I used the simple small batch solar water heater and I still keep that for emergency back-up and for camping. It is very convenient to fill the bottles in the morning before going to work and when I get home I have hot water for a shower and washing dishes. For temporary use and just for a back-up system this is what I would go with.

The larger solar batch heater works well if you get good sun all year but you will probably have to drain it for winter use.

Now I have one of the small on-demand propane water heaters and I love it. These use only a small amount of propane and gets the water very hot for a nice shower and if you will be washing lots of dishes and clothes I would go with one of these.

You could also heat water on a wood stove and they make wood stoves with a water basin attached. However if you will be using this in summer it will also heat your house up.

Here is a PDF for building your own: [PDF] : How to build a safe, effective wood-fired hot *water heater* T

Here are some videos for other solar hot water heaters that look doable:

Solar heating - **hot** shower using **bottles**

This movie shows a **bottle heater**, where the **hot water** is used for a shower. All movies are available in full length at vimeo.com More info at www ...

by EMASbolivia | 1 year ago | **4,675 views**

http://www.youtube.com/watch?v=2Qpi2rhdPuw

Solar Water Heater "Japanese eco-friendly bath" -ecoideasnet

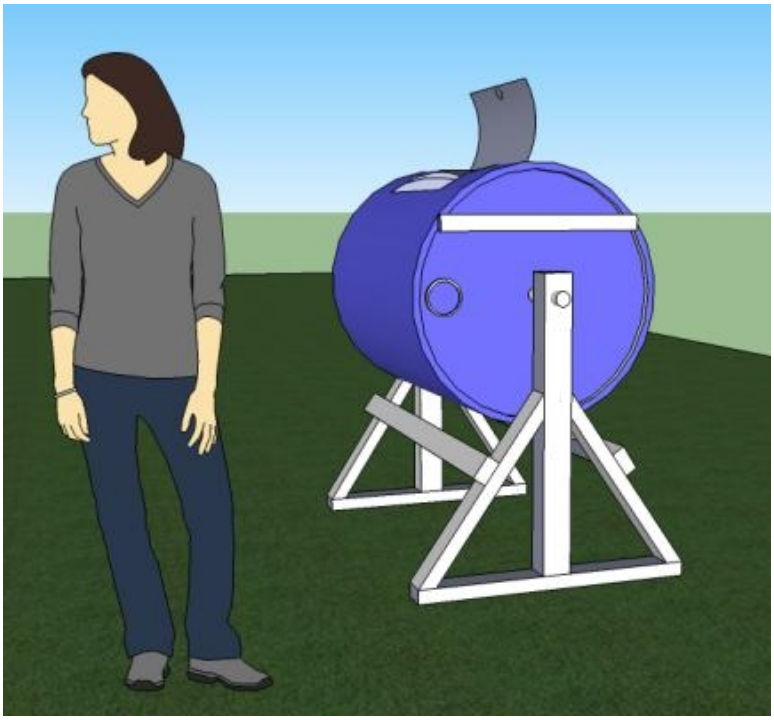
eco-ideas.net twitter.com Japanese love taking baths. The question is how to make baths eco-friendly. One answer is to do it yourself. This ...

by ecoideasnet | 1 year ago | **3,178 views**

http://www.youtube.com/watch?v=GuC1i5oLWVo

Compost Tumbler or Clothes Washer

This project can be used as a compost tumbler or with a simple modification it can be used as a clothes washer.

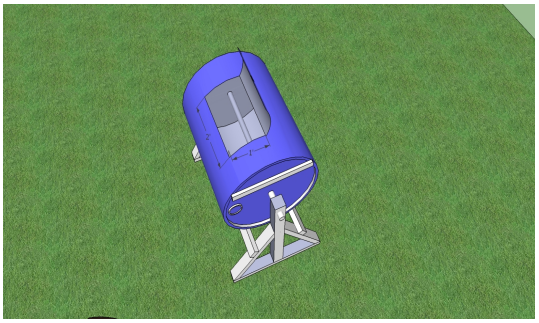


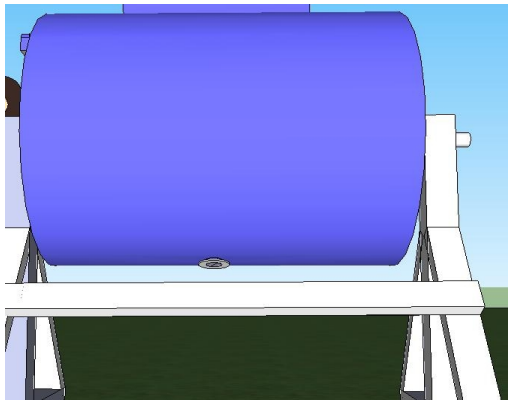
This project is built from a plastic 50 gallon barrel, five 2x4x8's and a 1 inch diameter 5 foot long steel pipe. You will also need a short piece of strap hinge, S hook latch and a 1 inch drain plug.

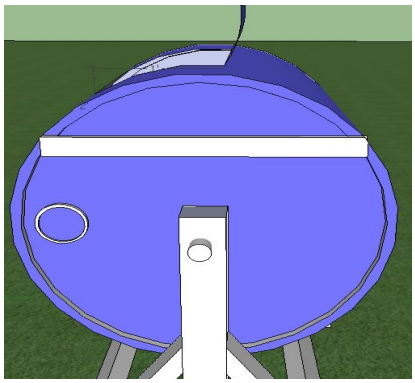
Step #1
Cut a 1 foot by two foot door on one side of the barrel. Use the cut out piece to make the door using the hinge and the S hook latch.

Step #2
Drill a one inch drain hole on the bottom side of the barrel opposite the door and insert the drain plug.

Step #3
Attach a 1x2 scrap to the top end of the barrel using glue and screws to be a handle for turning.

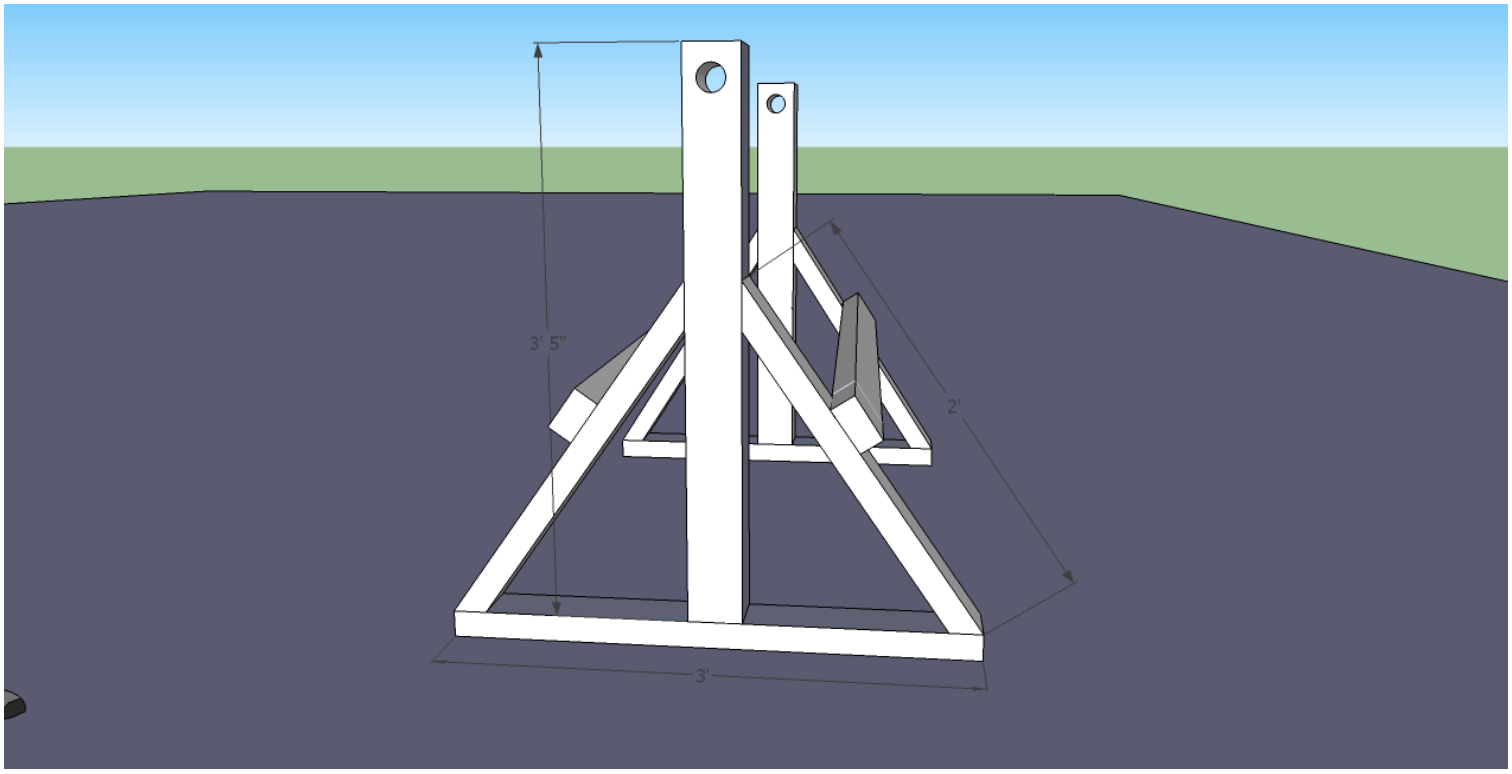


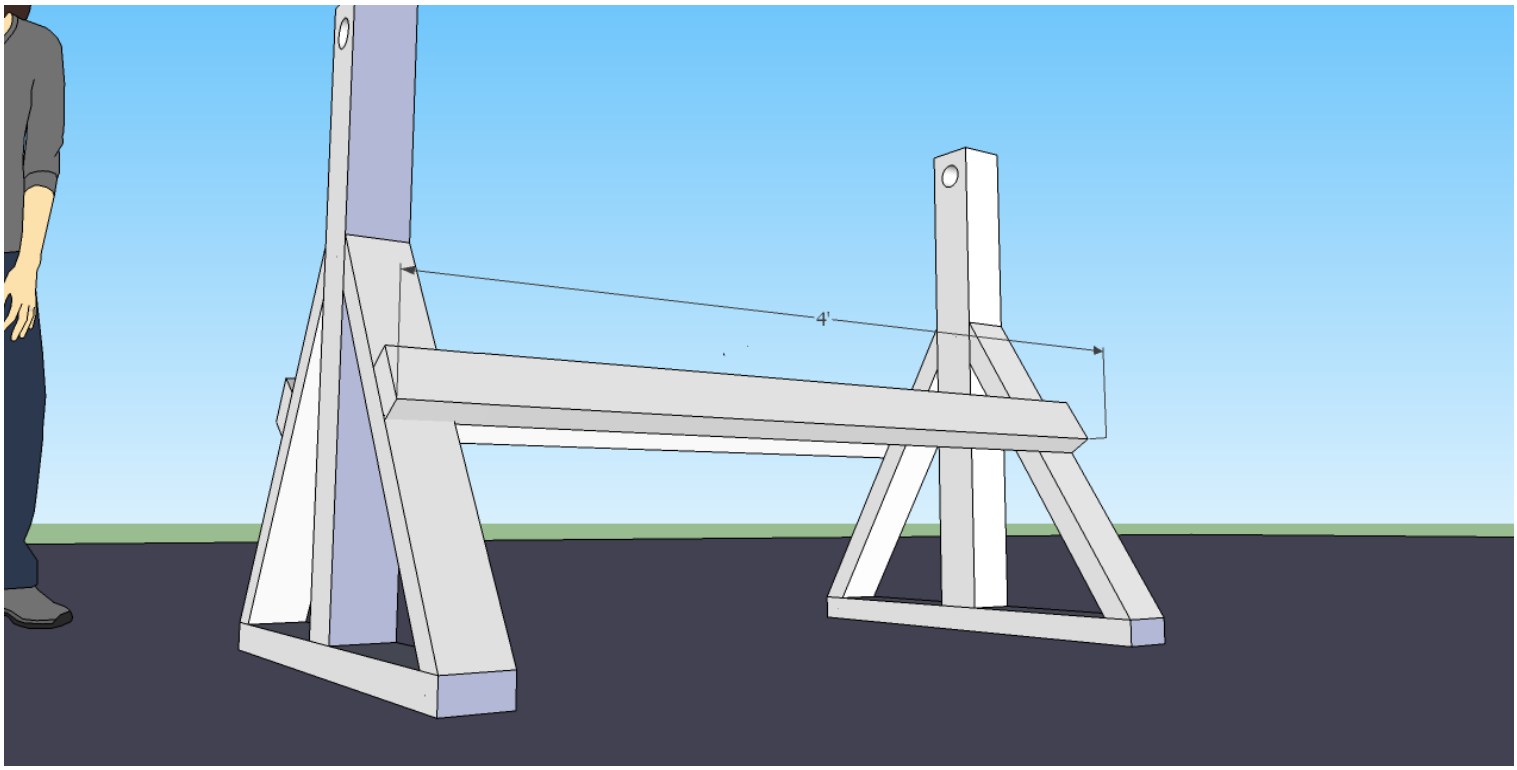




Step #4
Drill a 1 inch diameter hole in the end of each barrel and slide the length of pipe through these holes

Step #5
Build the frame using the dimensions shown here and attach the wood together using glue and screws. The upright frame member is two 2x4x3'5" glued together





How it works

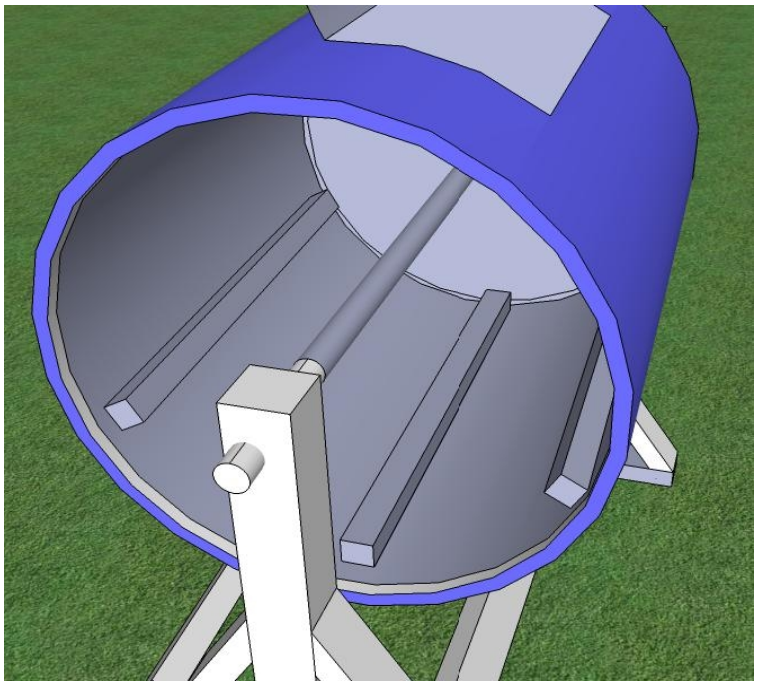
Just slide the 1 inch pipe through the barrel and the frame and you are ready to compost. Put in all your kitchen food scraps except for meat and add in your grass and weed clippings.

Using the attached handle give the composter a few turns back and forth to aerate and turn the compost every few days. In a few weeks you should have rich black compost that can be added to your garden, fruit trees or shrubs.

If you want to make compost tea just pour in a gallon or two of water and let it steep for a day and then drain the liquid off into a bucket using the drain plug. This compost tea is an excellent fertilizer for your house plants and vegetables.

To Make The Clothes Washer

By just adding a few agitator boards to this project you can also make a very good clothes washer.



Insert three 1”X2”x3' boards through the door (don't cut end of barrel) and attach at even spaces around the sides of the barrel as shown in the picture with roofing screws and rubber washers. Screw in the screws through the outside wall of the barrel in to the wood agitator boards.

How it works

Just put in your clothes to below the middle and fill the washer up with just enough water to cover the clothes and your biodegradable detergent. Close the door and using the handle start rocking the barrel back and forth. The agitator boards will scrub the clothes clean.

Drain the dirty water into a bucket for use on your shrubs or fruit trees. Refill the barrel with water and agitate again to rinse the clothes. Repeat as necessary. Drain the barrel and agitate the clothes to spin out excess water. Hang the clothes in the sun and you are done.

Other Clothes Washing Ideas:

For simple clothes washers you can also use the plunger and 5 gallon bucket method or I have a wonderwasher for small loads.

[$22.25 from Amazon]

[$59.95 from Amazon]

[Hand Clothes Wringer]

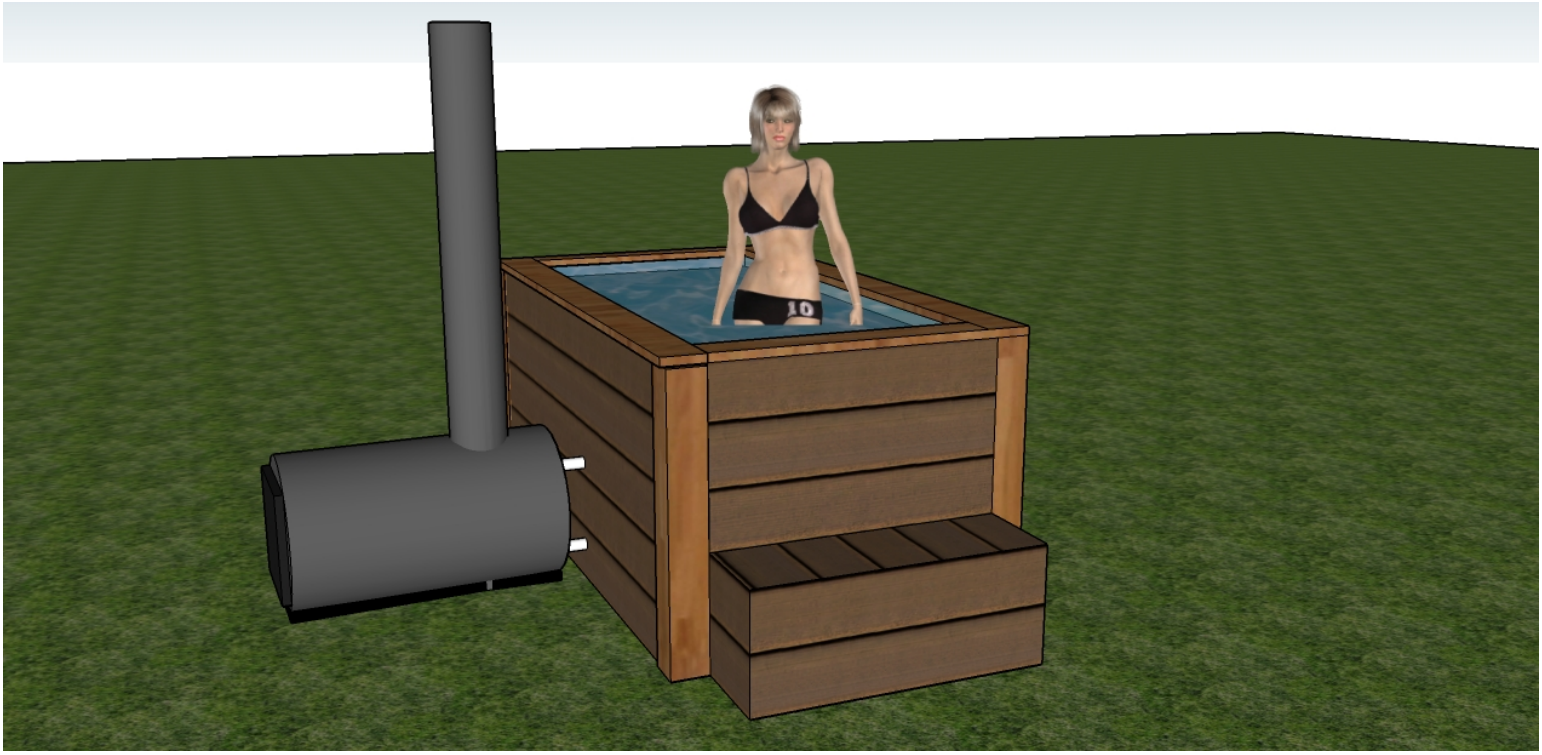
Drying Clothes

For centuries people have dried their clothes in the sun on a clothes line and it still works just fine today but here is a simple solar air clothes dryer that works faster and keeps clothes from freezing in winter and protects them from wind blown dirt and bird droppings.

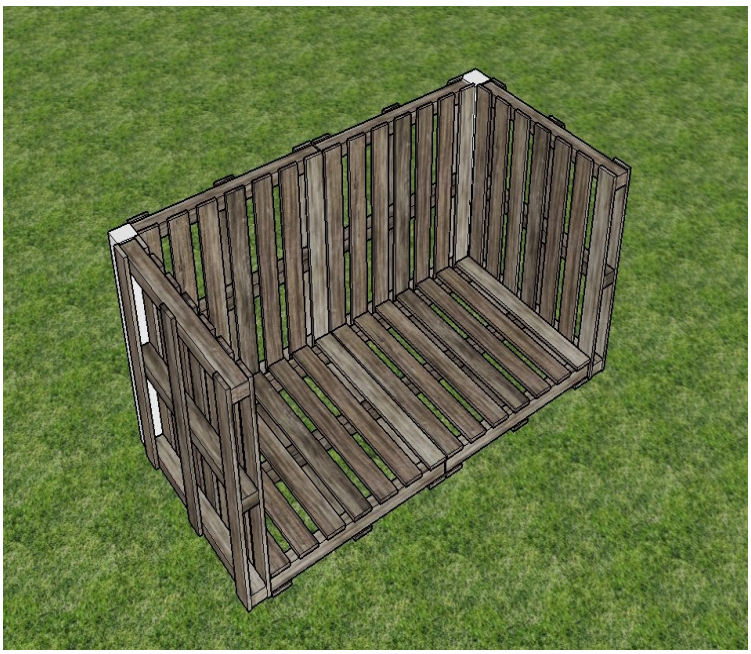
Frame is made from 2”x2” lumber and back is plywood. Cover the sides and top with heavy duty clear plastic sheeting. A 1 inch hardwood dowel holds the hangers. Just position the box so it faces the sun and place your clothes on hangers on the rack and close the door. The dryer will get very warm even in winter sun and the clothes will dry much faster as the water is evaporated.

Pallet Hot Tub

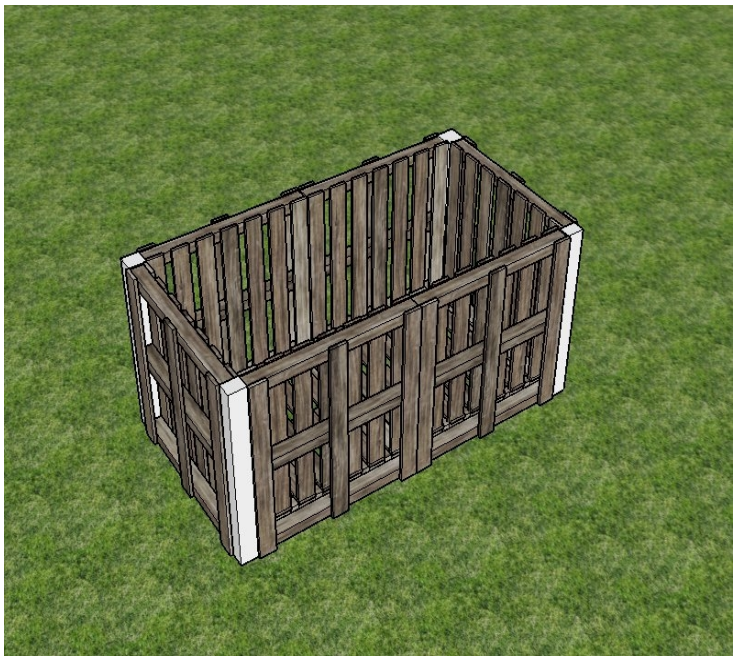
Nothing beats a long soak in a hot tub after a hard days work and this one can be built cheap from pallets and scrap wood and heated with a homemade wood stove of solar water heater. Sorry guys- the girl is not included :-)



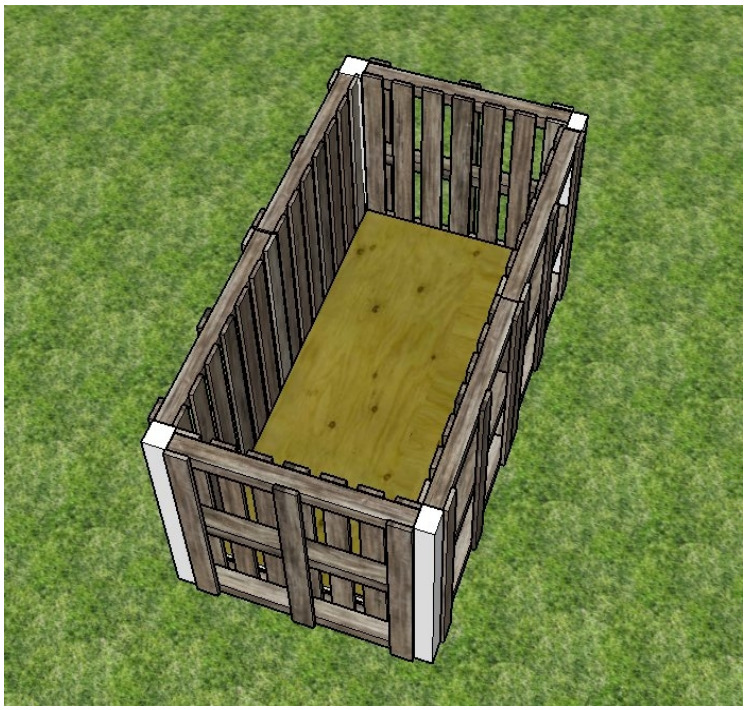
You will need 6 pallets the same size. Four sheets of plywood or exterior sheathing. A roll of HD black plastic or old pool liner. Four 2x4s. Some scrap cedar or other trim, glue and screws.



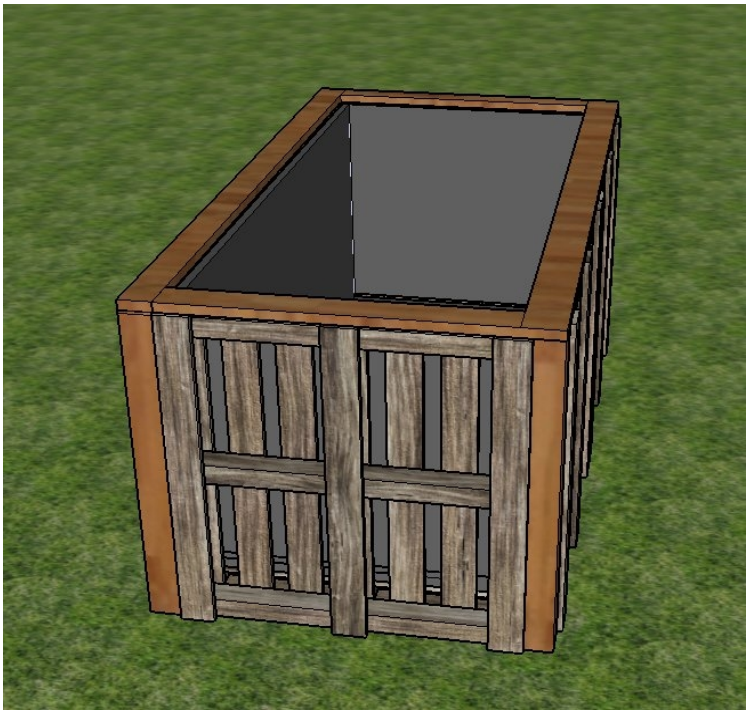
Attach the corners of the pallets using 2x4s



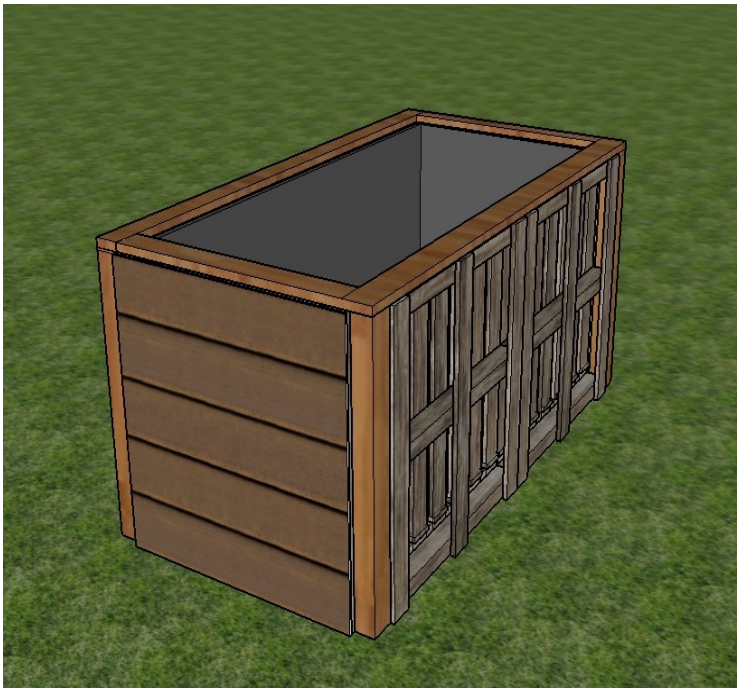
Should look something like this

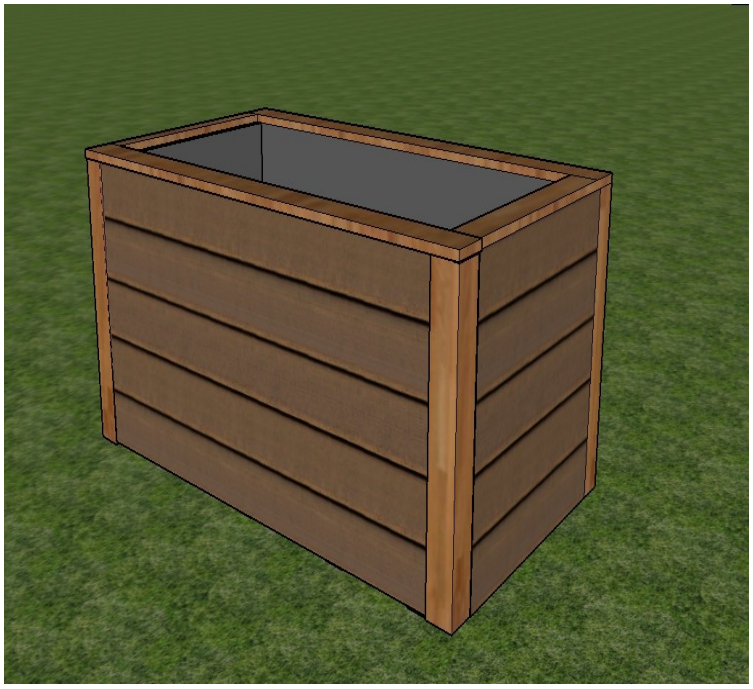


Cut a piece of plywood to fit the floor

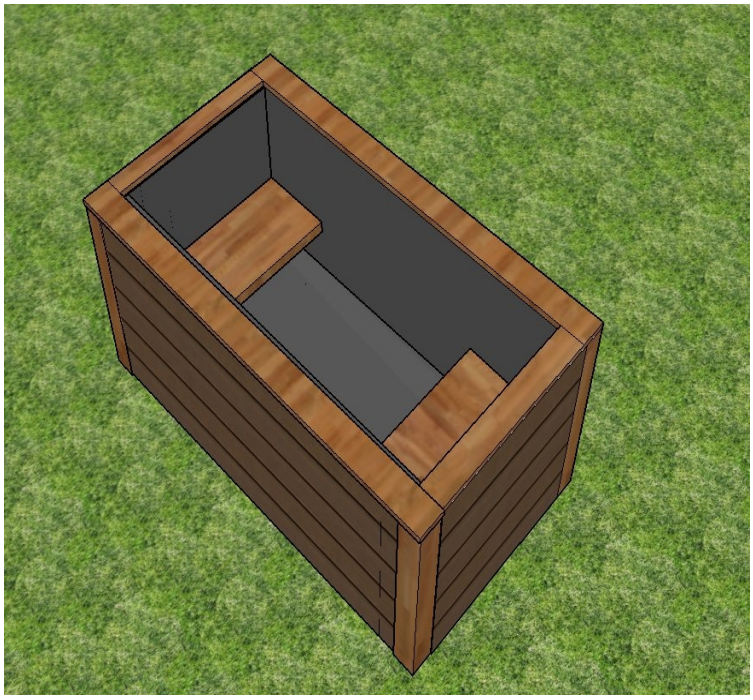


Lining is 3 layers of HD black plastic or old pool liner. Cover the edges with cedar or other trim

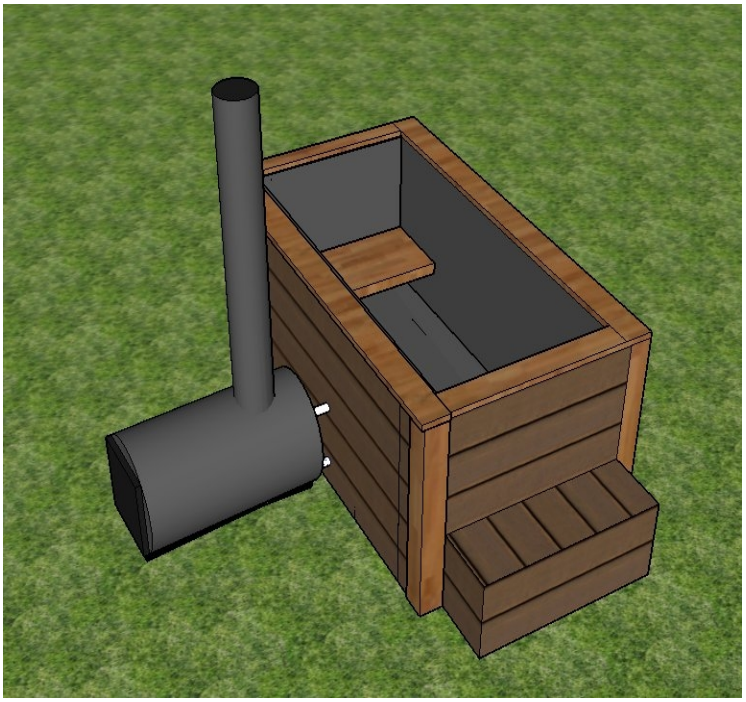




Cover the ends and sides with plywood and finish the corners with Cedar or nice trim wood.



Seats should be plastic if used



Build your step and heater (shown below)

Build a wood water heater

These Vogelzang barrel heater kits have been around for a long time and are the easiest way to convert a 35 or 55 gallon barrel to a great wood stove that can also be used to heat your cabin.

Use a layer of good dry sand or fire brick in the bottom of the stove to prevent a burnout. These take an 8" flue.

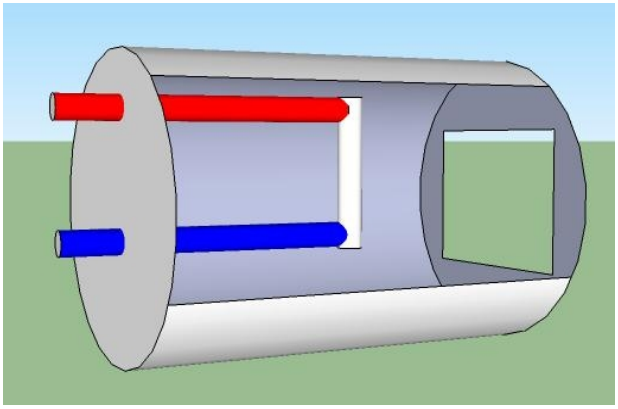
Directions are included with the kit:

Order from Amazon

To make the water heater all you need is some lengths of 1 inch steel or copper pipe, two pipe elbows, stove cement and some rubber gaskets.

Pipe lengths will depend on size of your stove. Seal around pipes to stove with stove cement. Rubber gaskets on inside and outside of hot tub.

When water heats it rises and will pull cool water in and push hot water out as long as the fire is hot.



Creative Homesteading

by LaMar Alexander

Creative Homesteading: self Help

This book is for anyone that loves creative houses and would like to learn how they are built, the materials used, tips for building, and the benefits and drawbacks of each design.

We will cover cabins, earthships, domes, yurts, undergrounds, containers, straw bale, pole barns, campers, pallet, cob, rock, tent, hogan and many more creative homes.

Also included in this book:

- Many links to complete plans for each of the creative homes described
- Sources for materials from respected dealers
- Instructions for finding cheap homesteading land
- Instructions for basic Off-Grid Solar installation
- Instructions for building a composting toilet
- Instructions for harvesting rain water and gray water
- Sources for homesteader supplies and equipment you may need

LaMar Alexander is an Author and long time Off-grid Homesteader that lives in a solar cabin at the foot of the Uintah Mountains. He has dedicated his life to preserving and teaching homesteading and off-grid simple living skills. His work includes Simple Solar Homesteading and Off-Grid Solar: Installation and Maintenance Guide www.simplesolarhomesteading.com

Creative Homesteading
Copyright 2010
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ISBN: 678890A Alexander, LaMar 1964-

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20 Resources for homesteader products

"Our life is frittered away by detail... Simplify, simplify, simplify!
-Henry David Thoreau

CHAPTER ONE

What is creative Homesteading ?

Creative Homesteading is what we call homes that do not fit the typical stick built everyday common homes that we see in every neighborhood in America!

They may use traditional or non traditional building materials or a combination of both. They are usually less expensive to build but may take more skill and time to construct.

Many use recycled materials, choose natural materials over man made, or create a home out of something that was not originally intended to be a home.

Creative Homesteaders are people that choose to live in a unique and creative way that flows outwards into the homes they build. Many are artists, writers, poets, dreamers, and nature lovers who choose to be in harmony with the world and rejects society and the media's views of what a house should look like or how it should function.

Some creative homesteaders build out of necessity and others because they choose to express their creativity and share it with the world!

In this book you will see many examples of creative homesteading that we hope will inspire you to consider building a home that is non-traditional and incorporate non-traditional materials and recycled materials into you home.

We also share instructions to help you on your quest to find inexpensive homesteading land, install basic solar and wind power, build a composting toilet, harvest rain and gray water, and drill a water well. These are skills all good homesteaders should have!

As you read through this book you will see numerous links to other websites and sources of information. Some are direct links to download free or purchase plans for a creative homestead. These websites are independently owned and operated and while we have done our best to evaluate each link and provide only good information please do your own research before spending any money.

The information in this book is designed only to inspire and entertain you and is not designed to be detailed step-by-step construction plans. There are always risks involved in any construction project and injury and death from construction projects is possible. The author, LaMar Alexander assumes no responsibility for the use or misuse of information in this book.

Many pictures and quotes are used with the permission of the owner and some are from public domain. If you are aware that any material is used without permission please contact us and we will resolve the issue. homesteadernews@yahoo.com

Resources for Plans

There are many free resources for home construction plans and these are my favorites:

CHAPTER TWO
The cabins

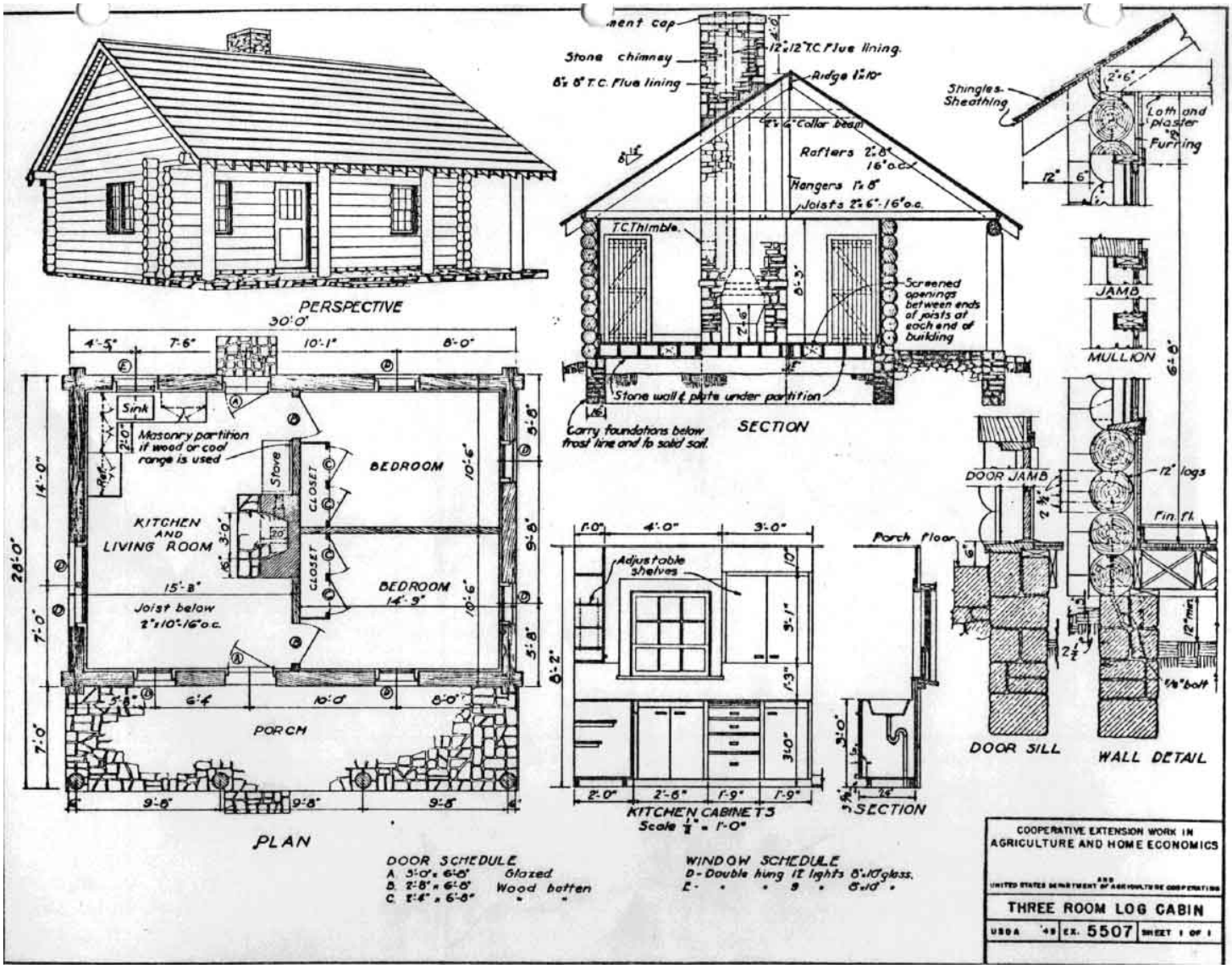
When people hear the word cabin they usually conjure up an image of a traditional log cabin like this:

A beautiful old square log cabin with rock fireplace

Logs were usually sawn from local trees and local rocks used for the foundation. The chinking was often mud that had to be fixed or a cement mortar. Hand split wood shingles, hand made window frames and rustic furniture completes the homestead.

Today there are many plans available for anyone wanting to build a traditional log cabin and even home use chainsaw log mills if you have the logs.

"Any fool can make things bigger, more complex, or more violent. It takes a touch of genius- and a lot of courage- to move in the opposite direction."
- Albert Einstein



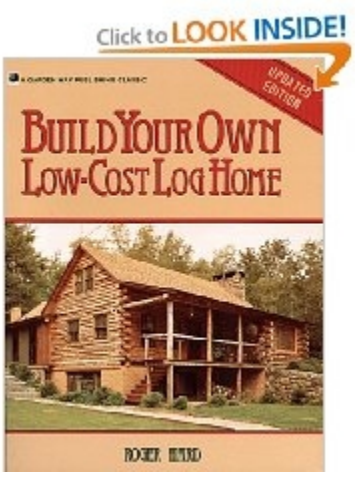
Three Room Log Cabin Plans

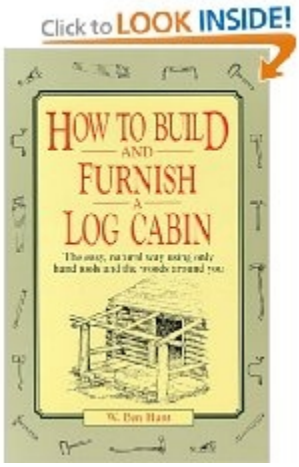
What you need to build a log cabin:

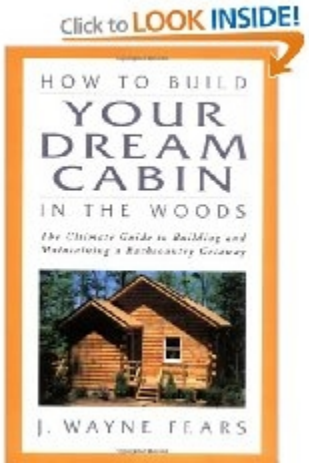
Cabin with loft

Probably one of the best detailed free plans for building a cabin like the one above comes from a Popular Mechanics December 1983 issue BASIC CABIN BUILDING PLANS

More log cabin plans and building manuals:







Vertical Wall Log Cabins:

traditional log cabins used long logs laid horizontally but sometimes shorter logs were all that was available and the a vertical wall log cabin was built like this one:

There are many advantages to building a vertical wall log cabin:

Faster Construction

The log cabin goes up fast. You don't have to make any fancy cuts or notches. Scribe fit methods take a lot of time even for skilled workers. With this method, all the cuts are square cuts easily accomplished with a chain saw.

The short logs also allow for faster construction because no heavy equipment is needed for lifting. One man or woman can move these logs around on their own. If the logs are allowed to dry the weight of each log is significantly reduced. If weight is very important, smaller logs can be used.

On Site Materials

Since you only need logs that are six feet long, a well treed one acre lot can easily provide enough material to build your walls. The cabin above was built from the logs found on the one acre site. It is not necessary to find a stand of straight, tall timber.

Logs of different sizes and even different shapes can be used. It is even possible to fit crooked logs together with this method without a lot of hassle.

Low Cost

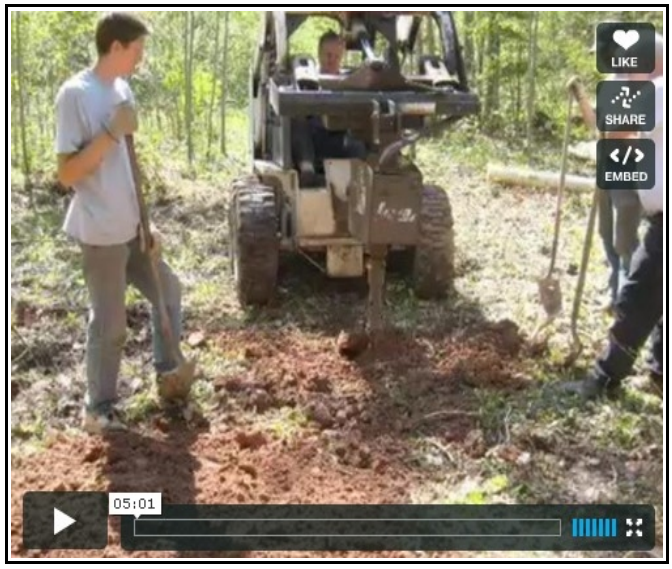
Because of the use of on site materials, it is possible in many parts of the country to build this 16X24 cabin for as little as $1,500. That of course means that one must think "low cost" throughout the project. The other costly items are your foundation, floor and roof. If those costs are kept under control, a $1,500 cabin is possible. That would not include any extras of course.

Vertical wall log cabin plans:

A SIMPLE LOG BUILDING METHOD

Have you been wondering about building your own cabin but are not sure you are ready to undertake a long hard task? Here is a simple method using only 6 foot logs that almost anyone can handle once they are dry.

http://www.alaskacabin.net/



Building a Vertical Log Cabin Video
by Andrew Lund

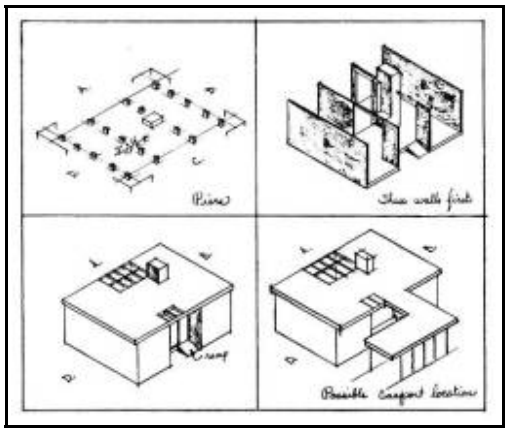
http://www.vimeo.com/4399176

Non-Traditional Cabins:

Many cabins are built that do not use logs at all or use a combination of logs and conventional lumber. My cabin is one of these:

My cabin is constructed from conventional lumber and uses a modified post and beam construction method for strength. Logs and rough cut lumber were used to give it that rustic log cabin feel. The cost to build my cabin was under $2000 not including windows and doors which were recycled.

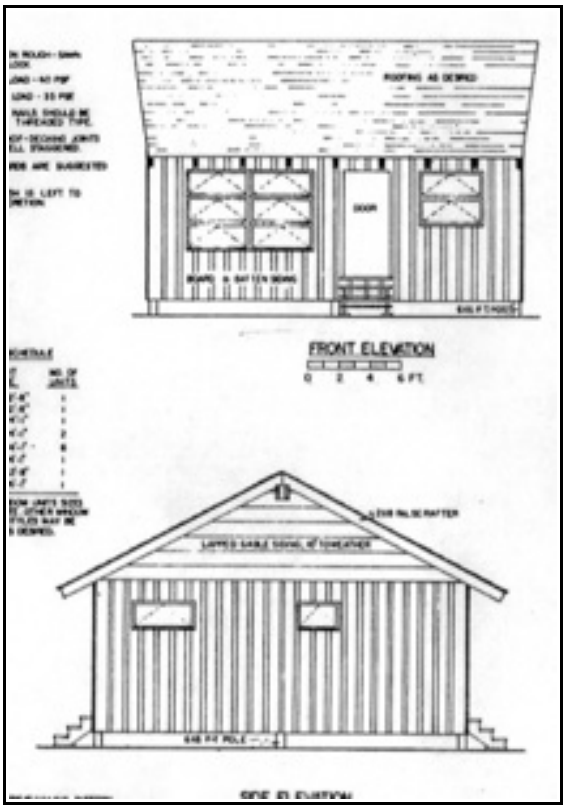
More non-traditional cabin plans:



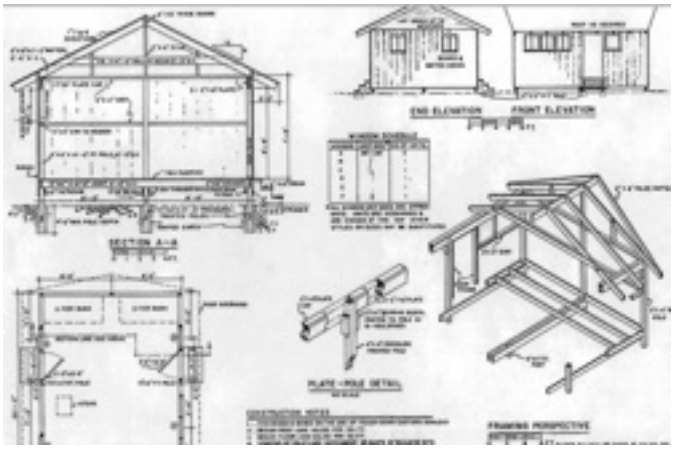
10 completely free cabin plans!

http://www.freeloghomeplan.com/index.php

A frame cabin plans
http://bioengr.ag.utk.edu/extension/ExtPubs/Plans/6003.pdf



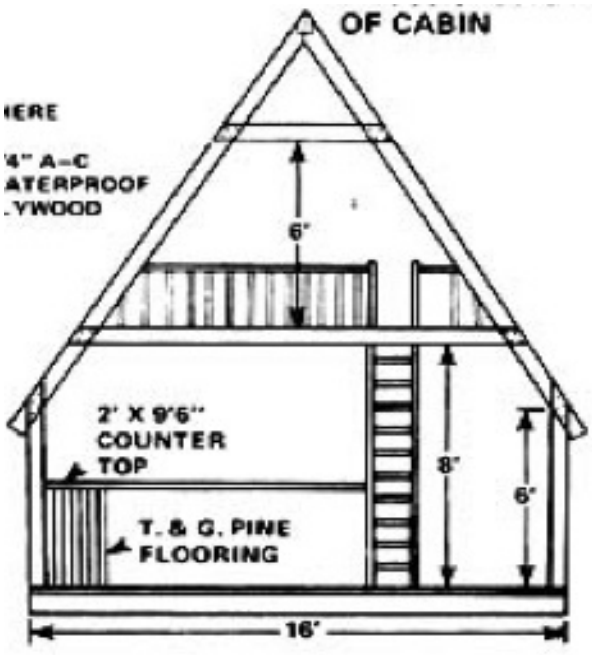
One bedroom Pole Frame cabin
http://bioengr.ag.utk.edu/extension/ExtPubs/Plans/6002.pdf



16x20 Wood Frame Cabin
http://bioengr.ag.utk.edu/extension/ExtPubs/Plans/6004.pdf

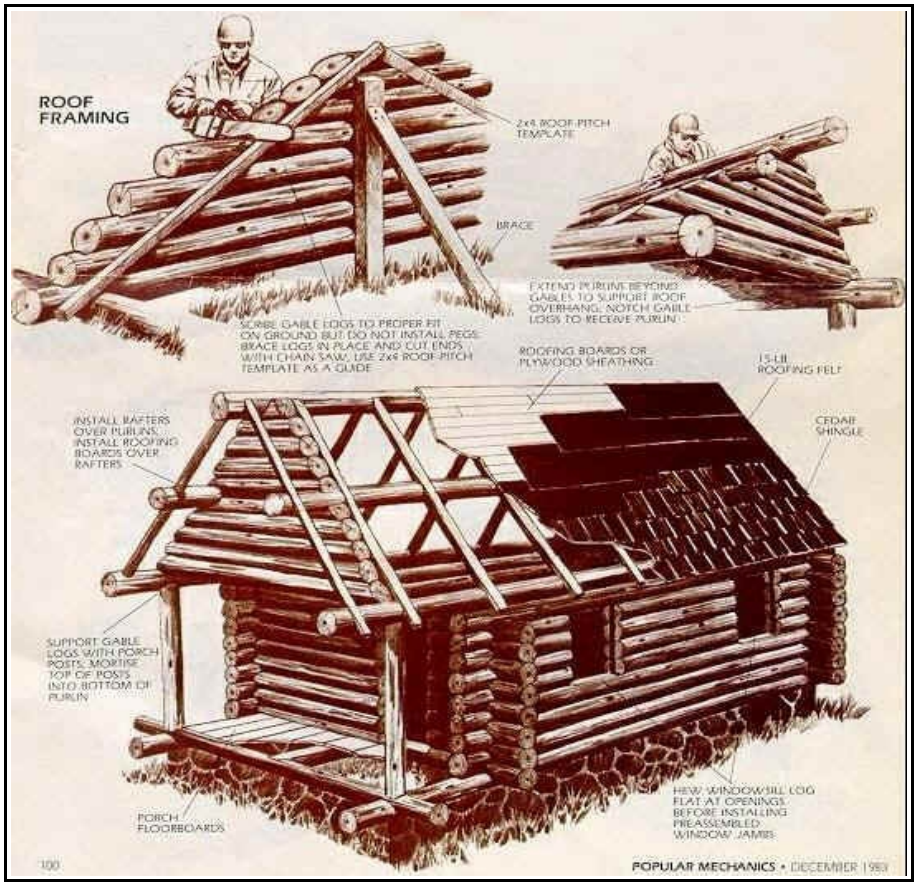
Two Bedroom Cabin

Modified A Frame Cabin

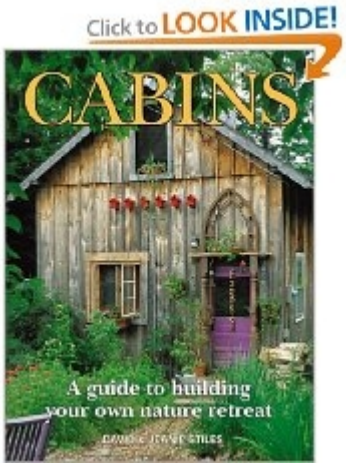


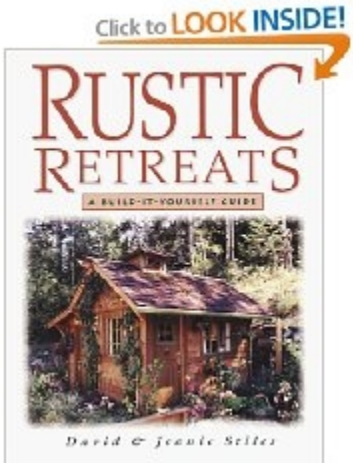
Resources for cabin plans:

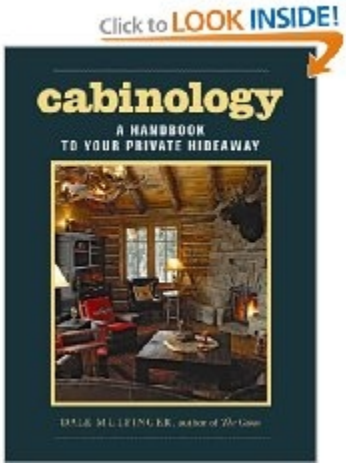
http://www.woodworkersworkshop.com/resources/index.php?cat=502

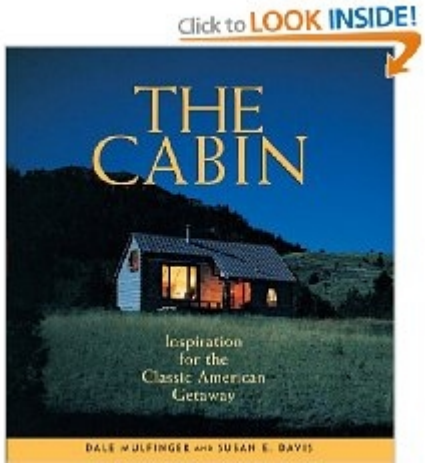

ROOF FRAMING
2x4 ROOF-PITCH TEMPLATE
BRACE
SCRIBE GABLE LOGS TO PROPER FIT ON GROUND BUT DO NOT INSTALL PEGS. BRACE LOGS IN PLACE AND CUT ENDS WITH CHAIN SAW, USE 2x4 ROOF-PITCH TEMPLATE AS A GUIDE
EXTEND PURLINS BEYOND GABLES TO SUPPORT ROOF OVERHANG. NOTCH GABLE LOGS TO RECEIVE PURLIN
ROOFING BOARDS OR PLYWOOD SHEATHING
15-LB ROOFING FELT
CEDAR SHINGLE
INSTALL RAFTERS OVER PURLINS. INSTALL ROOFING BOARDS OVER RAFTERS
SUPPORT GABLE LOGS WITH PORCH POSTS. MORTISE TOP OF POSTS INTO BOTTOM OF PURLIN
PORCH FLOORBOARDS
HEW WINDOWSILL LOG FLAT AT OPENINGS BEFORE INSTALLING PREASSEMBLED WINDOW JAMBS
100
POPULAR MECHANICS • DECEMBER 1983

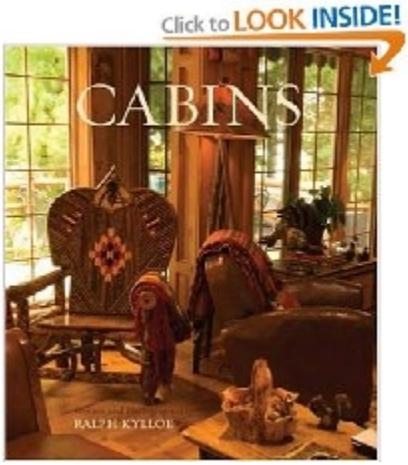
Recommended Cabin Building Books:

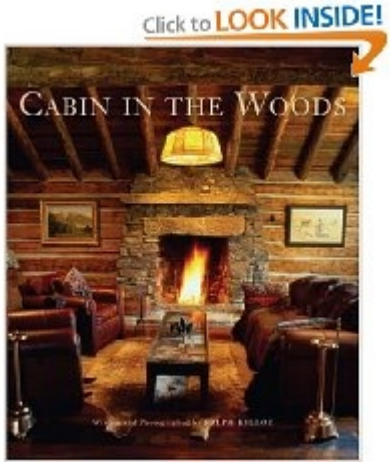


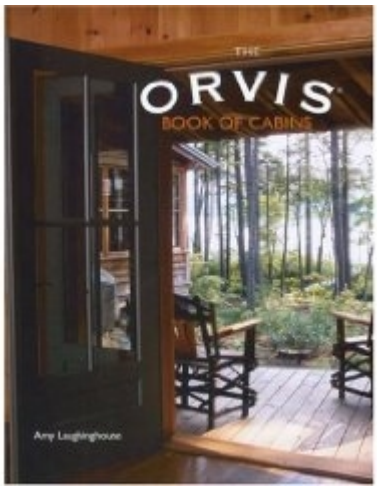


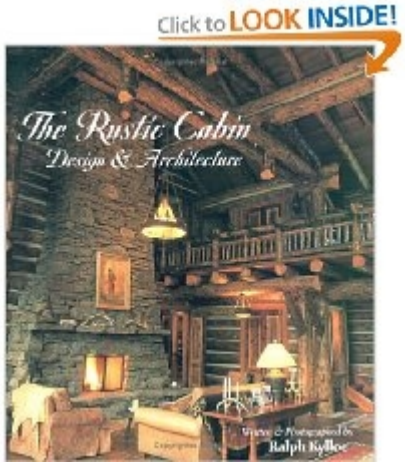


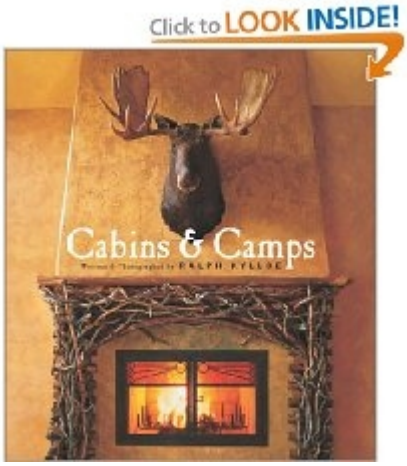












Recommended Videos:

Log **Cabin Chinking**

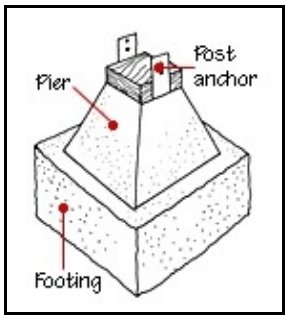
1 min 7 sec - Aug 22, 2008 -★★★★☆
Do your own log **cabin chinking** - Joe shows you the tricks for how to **chink** a **cabin**.
www.youtube.com/watch?v=bR19AY4rpxs - Related videos

Qdogsman
June 04, 2009
This video shows how the log walls are chinked with brick mortar.
http://www.youtube.com/watch?v=1D5r71tdWeM

Cabin building process
Half Dove Tail cabin
http://www.youtube.com/watch?v=GbiX5xBIYmE

Building The Cabin
16x20 Basic cabin
http://www.youtube.com/watch?v=uoRxiFt5CC8

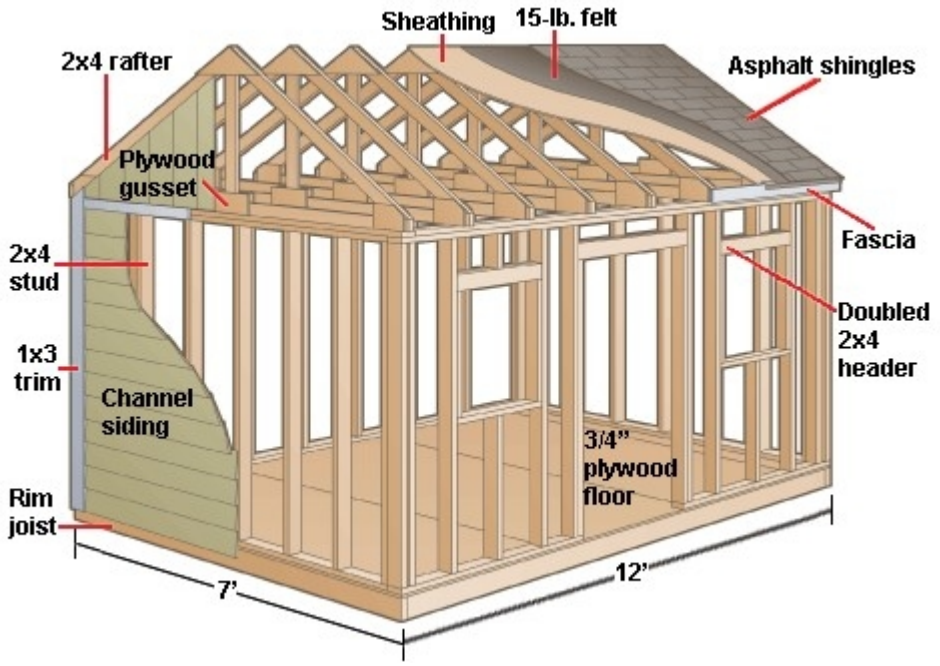
Foundations and Footer Instructions:



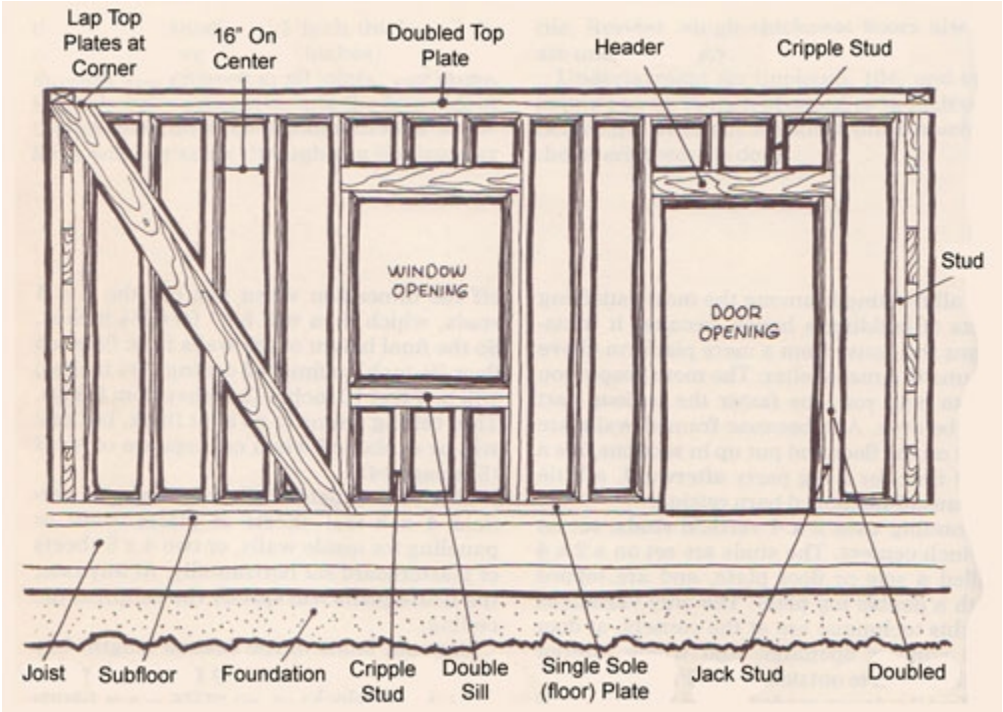
Post and Beam Foundations
Used where a poured concrete pad or foundation would not be practical. Deck blocks, piers, and poured footings are less expensive.

Concrete Footings
Used where a continuous footer is wanted and frost heave is not a concern.

Basic Cabin Framing:



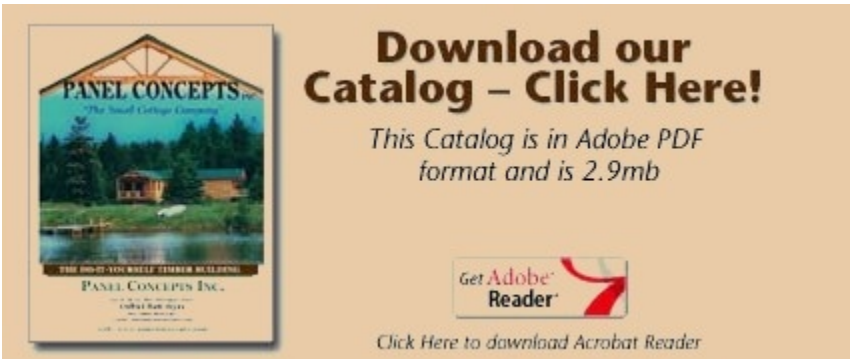
http://www.hometips.com/diy-how-to/gable-shed-build.html



http://www.small-house-building.com/wall-framing-basics.html

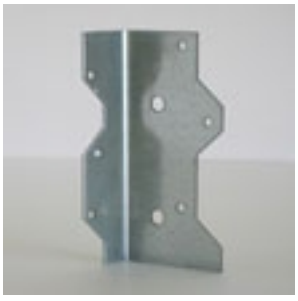
Cabins come in many shapes and styles:

Cabin and shed kits:


PANEL CONCEPTS
Download our Catalog – Click Here!
This Catalog is in Adobe PDF format and is 2.9mb
Get Adobe Reader
Click Here to download Acrobat Reader

Fast Framer Universal Storage Shed Framing Kit

NO ANGLES TO CUT! Unique galvanized steel angles and base plates make erecting a building fast and easy! Perfect for constructing a storage shed, tool shed, mini-barn or boat house. Kit includes 24 steel angles, 12 base plates, material lists and plans for a 7 ft.W x 8 ft.L, an 8 ft.W x 14 ft.L, and a 10 ft.W x 22 ft.L building. Order TWO framing kits for an 8 ft.W x 14 ft.L building; order THREE kits for a 10 ft.W x 22 ft.L building. Lumber and roofing materials not included. U.S.A.



Corner Angle Brace

Joist Hangar

Rafter Tie Down

Post Base

http://www.framingconnectors.com/

CHAPTER THREE

Earthships and Underground Houses!

What the heck is an Earthship ?

Earthships refers to a passive solar home made of natural and recycled materials. The homes are primarily constructed to work autonomous and are generally made of earth-filled tires, utilizing thermal mass construction to naturally regulate indoor temperature. They also usually have their own special natural ventilation system. Earthships are a type of off-grid home, which minimizes their reliance on public utilities and fossil fuels.

Earthships are built to utilize the available local resources, especially energy from the sun. For example, windows on the sunny side admit light and heat, and the buildings are often horseshoe-shaped to maximize southern (or nothern in the southern hemisphere) sunlight and warmth in the colder months. Likewise, the thick, dense outer walls provide effective insulation against summer heat.

Internal, non-load-bearing walls are often made of a "honey comb" of recycled cans joined by concrete and are referred to as tin can walls. These walls are usually thickly plastered with adobe or stucco.

The roof of an Earthship is heavily insulated - often with earth or adobe - for added energy efficiency.

England’s first Earthship, in Brighton, is designed to be an autonomous building. Made from a combination of recycled car tires and local, natural materials.

How it works:

“The glass covered south facing side of the house allows light in. As the sun warms the floor, the absorbed heat is radiated up into the house interior. The ground surrounding the house is at a constant temperature, meaning that in the winter the house will not drop below 14^{o}C. With such thick walls and roof, the Earthship has a large thermal mass resulting in a natural regulation of the indoor temperature. The structure will store heat well in the winter while keeping the interior of the building cool during the summer. Glass construction at the front of the house is designed for winter warming and summer cooling of the home. The Earthship is also often built with passive ventilation. That is, sunlight induced variations of temperature inside the Earthship are sufficient to cause natural convection (a circulation of air through the house).”- http://uwsp.wordpress.com/2009/11/11/earthships-have-nothing-to-do-with-aliens/

The Tire Walls:

It took 1400 old tires to build this earthship retaining wall

How to Build an Earthship:

10 Steps to building a simple earthship.

1. On the bare earth, mark the outer walls in a circular or U shaped layout.
2. Lay the first row of tires, shoulder to shoulder along the wall line.
3. Using the dirt from the inside of the wall line, firmly pack the tires until they are solid bricks. The earth cliff on the inside would be excavated down to roughly three feet in depth.
4. Stack the second row of tires, in a staggered layout, on top of the first, paying attention to keeping them level with each other. Continue this pattern until the walls have reached the desired height.
5. Fill any voids with empty pop cans and/or glass bottles and cover the tire walls, inside and out, with mud adobe, cement or stucco to create a smooth finished surface.
6. The roof can be domed shaped, formed from rebar that is wired or welded together then covered with chicken wire and cement. Other options would be log beams or even traditional trusses. A skylight/vent is included in the design to the rear of the structure to help regulate internal temperatures.
7. The front of the structure is a sloped greenhouse wall built upon a low wall of earth rammed tires and includes a large planter box on the inside. The glazing is recycled sliding glass door panels or similar materials. The entry door is constructed at either end of the greenhouse hallway.
8. Any interior walls are constructed of a cement and pop can matrix that is covered by an adobe finish. All the planter boxes are built the same way.
9. The house systems include a rain water catchment cistern, a battery bank, solar panels, power inverter and a composting toilet. The kitchen waste water is filtered via the greenhouse planters which grow fresh vegetables year round.

Finishing touches include tile or flagstone floors, glass bottle accent windows and wood inlays. Two story designs can include spiral staircases and just about any kind of custom design feature you can imagine.

The exposed surfaces on the outside of the structure are coated with a layer of cement, mud adobe or stucco as the climate demands. Most of the external tire walls are earth bermed and the roofing material is chosen to facilitate capture of rain water for use inside the house. Of course attention must be paid to things like drainage and choosing the best southern exposure for the greenhouse front of the dwelling, but other wise it is a pretty simple design.

Would you like more detailed instructions?

Several books have been produced to walk the do-it-yourself homeowner through the process and offer pictures of finished homes as well. Below is a selection of books on the subject that can take you step-by-step through the process of choosing the site all the way to customization of the finishing touches. -http://hubpages.com/hub/How-To-Build-An-Earthship

Recommended Books and blogs:

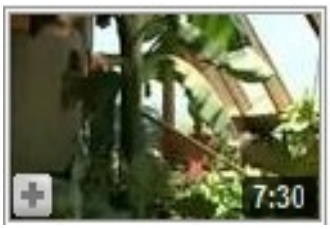
http://www.earthship.net/ http://www.squidoo.com/BuildAnEarthship

Earthship Videos:

Earthships 101 part I

Earthship n. 1. passive solar home made of natural and recycled materials 2. thermal mass construction for temperature stabilization. 3. renewable ...

★★★★★ 3 years ago 325,641 views earthship



Earthship Biotecture on the Weather Channel

Episode 128: "Alternative Homes" Original Air Date: 2007-08-25 Take a tour through a unique community in Taos, New Mexico. It features eco ...

★★★★★ 2 years ago 62,051 views earthship

Earthship Living

Here's a look at extreme green living, in an **Earthship**.

★★★★★ 1 year ago 38,302 views TheWeatherChannel

Earthship Biotecture on CNN International

Earthships: Future-proof buildings - sustainable, self-sufficient homes -- and the 50 or so that are scattered outside the New Mexico town of Taos ...

★★★★★ 2 years ago 50,475 views earthship

Rammed earth Tires Instructions:

TIRE METHOD

Wall framing using automobile tires.

Soil is then shoveled into the tire and compacted by repeated blows with a sledge hammer. Once packed with dirt, the tire walls bulge, interlocking with the tire row below.

The walls of the rammed-earth tire house are constructed by stacking tires on top of each other in a running bond type pattern (each row off 1/2 tire from the one above and below).

Underground Homes:

Underground or subterranean homes are very unique and creative but actually were used by many old homesteaders where logs were not plentiful. These earth covered homes were called Soddys because they were constructed from sod and whatever rocks and wood the home builder could find.

The "Soddy" at the Wind Mill Museum in Shattuck, Oklahoma.

Interior of Soddy

Sedona's history dates back approximately 10,000 years when the first settlers to the area, Native American cave dwellers, inhabited the caves in and around the Sedona area. The Hopi Indian's, in a feat that is still marveled at today, grew corn, beans and squash in an area where only 15 to 20 inches of rain falls per year. Examples of the four- and five-story structures built by the Sinagua, Anasazi and Hohokam tribes, such as Montezuma's Castle or the Casa Grande ruins, provide excellent examples of early life in the Sedona area. Why the last tribe disappeared around 500 years ago still remains a mystery to this day.

Sedona Arizona Anasazi cave dwelling

Modern subterranean homes:

Dug into a hillside in a secluded part of Wales, Hobbit homes, or rather low impact woodland homes, are springing up all over the place thanks to the Lammas Project. This project is the first of its kind and aims to demonstrate the viability of low impact living as a settlement model. The development of an eco-village is set to take place in 2008 in Pembrokeshire, as this is one of the only county's in the UK (apart from Milton Keynes) to have a planning policy for low impact Development...

Also known simply as an *earth home*, a dwelling that is partially or totally underground or that has earth berms around some or all of its exterior walls.

Earth-sheltered homes can be tailored to a wide range of climates and a variety of building sites – even flat ones. Combined with passive solar design, an earth-sheltered home can save tens of thousands of dollars in fuel bills over a lifetime. Earth-sheltered homes are comfortable, affordable and energy efficient. And, if thoughtfully designed, they allow in plenty of natural light and are far less of an imposition on the landscape than conventional above-ground houses.

Advantages

There are many advantages to earth-sheltered construction. An earth-sheltered home is less susceptible to the impact of extreme outdoor air temperatures, so you won't feel the effects of adverse weather as much as in a conventional house. Temperatures inside the house are more stable than in conventional homes. And with less temperature variability, interior rooms seem more comfortable.

Because earth covers part or all of their exterior, earth-sheltered houses require less outside maintenance, such as painting and cleaning gutters. Constructing a house that is dug into the earth or surrounded by earth builds in some natural soundproofing. Plans for most earth-sheltered houses "blend" the building into the landscape more harmoniously than a conventional home.

Finally, earth-sheltered houses can cost less to insure because their design offers extra protection against high winds, hailstorms, and natural disasters such as tornadoes and hurricanes.

Disadvantages

As with any type of unusual construction, there are some disadvantages associated with earth-sheltered housing. Principal downsides are the initial cost of construction, which may be up to 20% higher. Also, an increased level of care is required to avoid moisture problems, during both the construction and the life of the house.

It can take more diligence to resell an earth-sheltered home, and buyers may have a few more hurdles to clear in the mortgage application process.

Site-specific factors for earth-sheltered home design

Before deciding to design and build an earth-sheltered house, you need to consider the building site's climate, topography, soil, and groundwater level.

Climate and topography

The climate in your geographical area will determine whether an earth-sheltered house can be a practical housing solution. Studies show that earth-sheltered houses are more cost-effective in climates that have significant temperature extremes and low humidity, such as the Rocky Mountains and northern Great Plains. Earth temperatures vary much less than air temperatures in these areas, which means the earth can absorb extra heat from the house in hot weather or insulate the house to maintain warmth in cold weather.

The site's topography and microclimate determine how easily the building can be surrounded with earth. A modest slope requires more excavation than a steep one, and a flat site is the most demanding, needing extensive excavation. A south-facing slope in a region with moderate to long winters is ideal for an earth-sheltered building. South-facing windows can let in sunlight for direct heating, while the rest of the house is set back into the slope.

In regions with mild winters and predominantly hot summers, a north-facing slope might be ideal. Every site differs, but generally southern exposures offer more sun and daylight throughout the year than north-facing slopes. Most designs can be built to take advantage of each site.

Soil

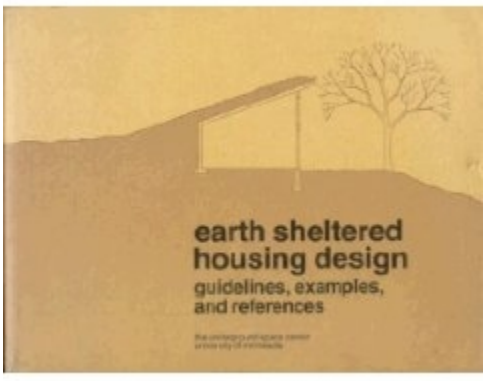
The type of soil at your site is another critical consideration. Some types of soil are more suitable than others for earth-sheltered construction. For example, the best soils are granular, such as sand and gravel. These soils compact well for bearing the weight of the construction materials and are very permeable, which means they allow water to drain quickly. The poorest soils are cohesive, like clay, which may expand when wet and has poor permeability. Soil tests, offered through professional testing services, can determine load-bearing capability of soils and possible settlements that may occur.

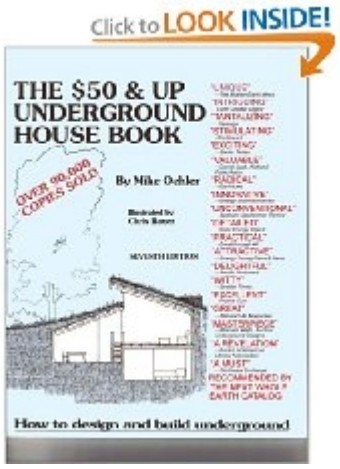
Radon is an invisible and odorless radioactive gas produced naturally when uranium in rock decomposes. It is found in the soil and in outdoor air in harmless amounts, but can reach dangerous levels when trapped. Radon levels are another factor to consider in locating your home. Areas with high concentrations of radon can be hazardous, although there are methods that can reduce radon buildup in both conventional and earth-sheltered dwellings.

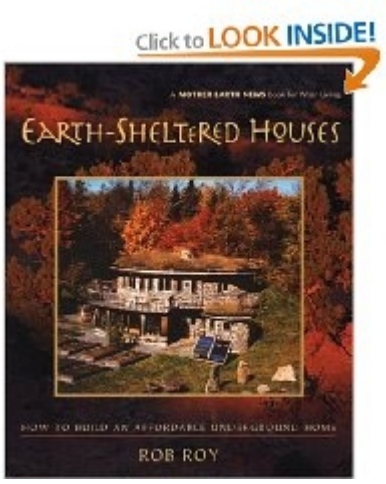
Groundwater level

The groundwater level at your building site is another important consideration. Building above the water table is almost essential. Choosing a site where the water will naturally drain away from the building is the best way to avoid water pressure against underground walls. The site should be surveyed for low spots and areas where water will collect. Seasonal or regular surface water flows should be channeled away from the structure. Drainage systems must be designed to draw water away from the structure to reduce the frequency and length of time the water remains in contact with the building's exterior. Underground footing drains similar to or greater than those required by a house with a basement are necessary in many cases.

Recommended Books:







Types of Wall Materials:

Tin Can and Bottle Walls

Can/bottle walls look and act like normal walls, except that they can't bear heavy loads. They're much, MUCH faster to build than tire walls, but don't have the benefit of thermal mass. In Earthships, they're used for room dividers, garden walls, and other non-load-bearing verticals. You can literally learn how to make one in five minutes; they're cheap as free and extremely easy to put up. So, here's how! Click here for more information

A beautiful bottle end shower wall

Here's how to make cob

Cob is mixed with a combination of stirring and compression. In my experience, the best way to achieve this combination is with feet and tarps.

Clear a few places at the site for mixing areas. The closer they are to the foundation, the less energy it'll take to get the cob to its destination. Inside the building is a good place for at least one mixing area. Leave enough room to walk around the mixing sites easily. Use your brain to minimize work. If you've imported ingredients, pile them in sensible places to streamline the process. For example, if the sand pile is two steps closer to the building (but not crowding walkways) you'll save miles of steps during the building process.

If you need to add sand or clay to your soil, you can measure out proportions by the shovel full, or by the bucket full until you can do it by eye and by feel.

Throw some soil on a tarp

Break up the clods with your tamper or your shoes

Adding sand

If you are adding sand, shovel the sand onto the tarp and stir it into the crushed soil until the two are well-mixed. You can do this by pulling up the edges of the tarp and rolling the ingredients around on the tarp.

Adding clay

If the soil you are working with is so sandy that you have to add clay, you can either add clay soup or add dry powdered clay to dry sand. Wear a mask when adding and stirring dry clay to your mix.

Stirring and treading the mix

Stirring and treading well is a big part of the magic that turns your ingredients into cob.

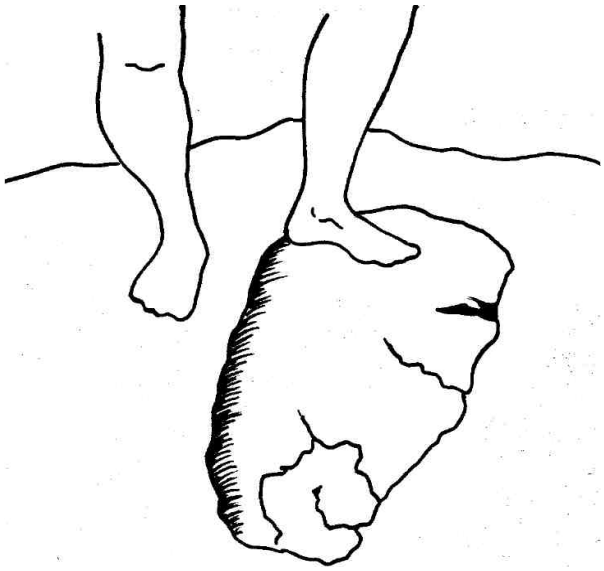
To stir, **stand on one edge of the tarp and lift up the tarp on the opposite side of the mix. Pull it *towards* you, turning the mix over onto itself.** Don't lift the edge of the tarp at your feet or push the mix to turn it. That's too hard on your back. The more you roll the tarp, the faster the cob mixes.

Then add **water**. You're after a cookie dough consistency. **Tread on the mix with your feet**. It's easier to feel the mix with bare feet, and for some mysterious reason, bare feet mix the cob faster than shoed feet. Don't despair, your feet will return to nature and toughen up quickly.

Stir the mix often by pulling up the edges of the tarp, while you're treading. It's impossible to tread the mix too much, so go for it. You'll notice how it changes plasticity as you tread on it.

If your soil has a lot of **sharp rocks** in it, you can gradually toughen up your feet or give in and wear shoes. Smooth soled ones work best because the cob doesn't stick to them so much. Another option is to sift the dirt through a 1/2 inch wire screen. This is a lot of work and puts dust into your lungs. Wear a mask if you do this! Breathing dust is bad for you! **Be aware that the clods that won't go through the sieve easily are the hardest and best pieces of high clay-content soil**. These can be forced through the sieve, or crushed and then sieved. Or these precious little lumps of clay can be soaked overnight, then put through the sieve wet or mushed up by foot. You can save the gravel that you end up with after sieving for your drains, or put it back into the cob after you've finished mixing it.

When your mix begins holding together in a giant loaf when you turn it with the tarp, it's time to add straw.



Adding straw

When you add straw to the mix, it will dry it out quite a bit. If the mix is too dry to add lots of straw, you can either add less straw or add water. You will soon get a feel for the consistency you're after. Remember this ancient knowledge is imprinted in your cells. Trust yourself. Experiment.

Flatten the cob loaf down by treading on it. Grab an armful of straw and sprinkle some onto the mix. Step on it so it sticks into the cob a little and pull the tarp up, making a cinnamon roll of dirt-dough and straw-sugar. Tread on it until it's flattened out into a pancake again, and add more straw. Make another cinnamon roll. Do this three or four times until you have enough straw in the mix. Too much straw will cause the mix to fall apart. Try adding a lot to a small mix so you can see what too much straw feels like.

Cob too dry?

A cob mix that's too dry will be crumbly, won't want to stick together very well, and won't take straw well. Add water and stir until the mix is the consistency of cookie dough. Too much sand or too much straw can also cause a crumbly mix.

Cob too wet?

When you build with a mix that is too wet, you'll see that it won't keep its shape because it can't hold up its own weight. It will start to bulge out on the sides of the wall. The technical term for this is "ooging". (All cob oogs. The wetter the cob, the sooner it oogs.) If it's too wet, add a little dry sand, dirt, or straw and tread it in. If you add a large amount of dry stuff, use roughly the same ratio of dirt and sand as your original recipe. You can also dry a mix by treading it into a pancake so the air can get to it, and letting it sit for a few hours or overnight. You'll quickly get a feel for it.

Letting the mix cure

Because **it is so much easier to mix the cob if it's on the wet side, you may want to do it that way and let the mix sit for a day or two** to dry out before you put it on the walls. When mixes sit, something magic happens and they become more elastic and easier to work. You'll get a feel for how wet to make them and for how much they'll dry during a night. If they're too wet, uncover them and let them sit a little longer. Once you get into the swing of cobbing, you can make mixes on all your tarps at the end of the day when you're warmed up. In the mornings you can get inspired and warmed up by cobbing onto the walls.

Curing is not necessary. It's fine to make a mix and put it directly onto the wall. I suggest you try letting a batch of cob sit, though, to see if you can feel an improvement.

Avoid leaving the mix covered for too long because the straw will start to rot and stink, and lose some of its strength. If you do this accidentally, it's no big deal, put it on the wall anyway. It will stop stinking as soon as it dries.

Other ways to mix cob

In the old days in Europe, farm animals were often used to mix the cob. The ingredients were shoveled into a circle around a post. The horses or oxen were tied to the post and walked round and round treading the cob mixture.

In recent times people have used various machines to make big batches of cob, and to speed up the process. **Caution**: if you let a batch of cob sit wet for too long, the straw will start to rot. It's a good idea to only mix big batches when you know you'll have time to get the cob onto the wall fairly soon. One strategy is to mix a big batch of the clayey soil and sand and add the straw to only the portion of the mixture that you know you can use within a week or so.

Cement mortar mixers will mix cob if you can handle the fumes and noise. As with manual mixing, the clayey soil and sand is mixed first, then the straw added. The cob has to be mixed wetter than with other types of mixing to allow the cement mixer to turn without too much stress. This means the mix may have to sit a day or two to dry to the right consistency. Straw can be added manually to the mix.

Tractors or four wheel drive vehicles can make quick work of the cob mixing job. I've seen the process happen unintentionally in peoples muddy driveways. Simply pile the soil and sand and drive back and forth over them. Add the straw after the other ingredients have been mixed well, then drive over the mixture again until it's well stirred.

Heavy earth moving machinery can be used to mix up big batches of cob. Front end loaders are great! They can do the job of compiling and mixing the ingredients. The finished cob mix can be scooped up in the loader and raised to the height of the wall. You can climb into the loader and hand-sculpt the walls without having to lift the cob up onto the wall by hand. -Courtesy weblife.org http://weblife.org/cob/cob_049.html

Recommended Videos:

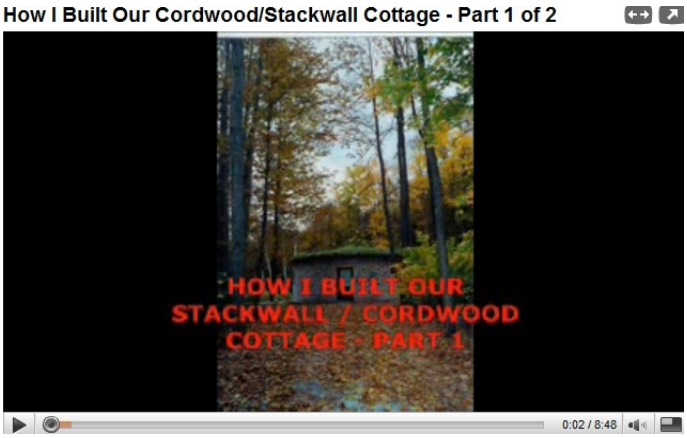
Building CordWood Walls

Cordwood construction utilizes short, round pieces of wood, similar to what would normally be considered firewood. For this reason this method of building can be very resource efficient, since it makes use of wood that might not have much other value. Cordwood building can also create a wall that has both properties of insulation and thermal mass. The mass comes from the masonry mortar that is used to cement the logs together, and the insulation comes from the wood itself and the central cavity between the inside and outside mortars. Like strawbale walls, many building authorities require a post and beam or similar supporting structure and then using cordwood as an infill, even though the cordwood method creates a very strong wall that could support a considerable load.

This method produces a look that is both rustic and beautiful. The process of building is similar to laying rocks in mortar, where the the logs are aligned with their ends sticking out to create the surface of the wall and mortar is applied adjacent to each end of the log. Typically the logs are not coated with a moisture barrier, but are allowed to breath naturally. It is possible to include other materials into the matrix, such as bottle ends that would provide light to enter the wall.

Recent experiments with the use of cob instead of cement mortar to join the logs have been encouraging and this method may provide a somewhat more ecological approach to cordwood building. In this case special care should be taken to have large eaves to keep water away from the wall.

After studying the wide array of "natural building" techniques for several years, I have come to accept cordwood as one of the greenest of all: it uses what is often considered a waste material, creates an insulated wall that requires no further finishing or maintenance over time, and can be done by relative novices...what more could you want?



Cordwood Homes:

Cordwood Home Construction by Eric Corey Freed

The ancient method of cordwood building produces beautiful, rustic-looking homes. The simplicity and charm of a row of stacked logs makes great use of a waste material to build your home.

The History of Cordwood

Cordwood structures can be found around the world, with the oldest standing ones in Greece dating back nearly a thousand years. In heavily wooded areas, using the scrap wood just made a lot of sense. Like most natural building methods, the tradition of cordwood had a rebirth with the green building movement.

What cordwood is

Cordwood construction stacks up short, round lengths of wood into a wall. Using what would normally be cast aside for firewood, cordwood looks like a stack of wood you'd have behind your fireplace.

The ends of the logs are left exposed, making efficient use of these leftover scraps of thick branches. The cordwood is held together with mortar, creating a wall with both high insulation and high thermal mass.

As with straw-bale walls, cordwood is not typically allowed to be structural and support the wall. Instead, the stacks of wood are used to fill in the wall between the pieces of a structural frame, even though the cordwood is incredibly strong on its own.

A variety of cordwood, from 1 to 6 inches across, is stacked up in a random pattern (see image below). The wood protrudes from the wall about an inch or so, giving the wall a textured look. The finished walls are anywhere from 12 to 24 inches thick.

You can find your own cordwood from a variety of sources, including fallen trees, timber mills, sawmills, and split firewood.

Tip: No matter where you find the cordwood, you'll need to remove the bark to prevent water from sneaking into the home. Nearly any type of wood can be used, but the best choice would be the naturally rot-resistant woods, such as cypress, cedar, or juniper. Choose a light wood to keep the logs from swelling and shrinking.

Ideally, you should use the same species of wood on each wall. This ensures that the wood will react to water and temperature the same way.

The process of building a cordwood wall is a lot like laying rows of brick. The logs are set with their ends sticking out, and mortar is placed between each piece. It's similar to the Lincoln Logs you played with as a kid.

You may be surprised to know that the logs are not treated or coated with anything. The ends are left to breathe naturally. If you like, you can use lime plaster, linseed oil, or sand to finish the exterior of the wall.

Cement-based mortar is typically used to hold the logs together, mixed with sand and sawdust to help it bond to the bare logs. Many green builders have been using cob (see the preceding section) as a mortar instead. The natural clay and straw of cob mortar is a more sustainable alternative, but you need to take the same waterproofing measures discussed in cob construction.

Remember: Practical needs, such as electrical wiring and plumbing, must be planned ahead of time and built into the wall.

Although a cordwood wall is incredibly dense and strong, most building codes will not allow you to use them to support the roof. In these situations, a structural frame of heavy timber or steel is used, and the cordwood is used as a fill in the structural frame. For load-bearing cordwood walls, the logs need to be woven together at the corners.
The logs are stacked up by hand, and a 3- to 4-inch bead of mortar is placed at each end. The mortar is kept about an inch away from each end and doesn't continue all the way through the wall. An air space is left inside the wall to insulate and to prevent water from soaking indoors.

The insulation value of cordwood varies based on the type of wood, the thickness, and the mortar. Generally, the finished wall is about the same as a traditional wood-frame wall. The mortar adds a thermal mass, which will keep the home comfortable year-round.

Taking Advantage of Cordwood

The thermal mass and insulation of cordwood allow it to be used in most climates. The walls are surprisingly dry, permitting you to use cordwood even in wet climates. Extreme cold or hot climates are not appropriate for cordwood walls, however.

The simple process of cordwood building does provide some special design opportunities. Very different from wood framing, cordwood creates a richly textured and rustic wall.

The individually stacked lengths of wood allow you some fun and creativity. Consider the following when building your cordwood home:

- **Placement:** Cordwood builders typically take great care in the arrangement of the logs. The goal is to accentuate the differences in the wood and have a random placement of sizes. The beauty of a cordwood wall comes from the exposed wood ends.
- **Decoration:** Homeowners usually decorate the mortar between the logs with anything they can find. Marbles, seashells, and pebbles are often pushed into the still-wet mortar to decorate the home.
- **Bottle windows:** Just as with cob, glass bottles can be inset into the wall to create a unique window. Place mortar between a stack of bottles to make a bigger window.

The random (almost sloppy) method of cordwood construction makes it a labor-intensive, but fun, way to build. The cheap (or even free) materials must be stacked by hand but go up quickly.

If you're doing the work yourself, a cordwood home will cost less than a wood-frame home of the same size. Compared to straw bale or cob, cordwood is the most affordable.

In addition to a lower construction cost, cordwood walls are maintenance free, eliminating the need of painting or siding.

Lowering Costs When Working Cordwood

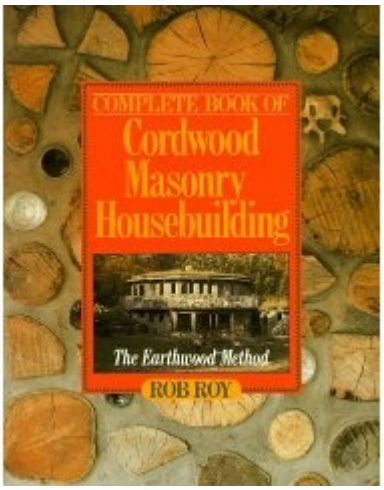
- **You'll save time and money if the source of the wood is nearby.** Cordwood requires a lot of small pieces of wood, and it's easy to underestimate how much you'll need. Transportation wastes money and energy, so stick with local sources.

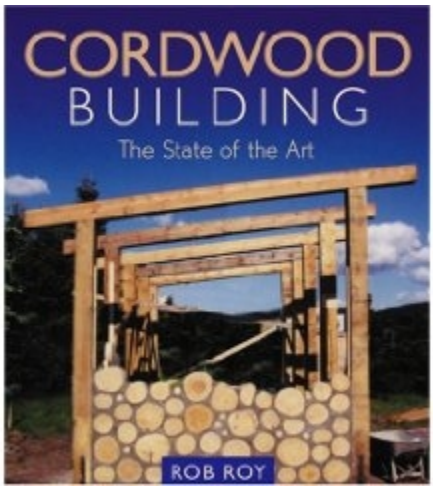
Rainwater splashing off the ground can cause the wood to rot. Run foundation walls 18 to 24 inches off the ground. Start your cordwood wall high to protect it from moisture and splashing rain.

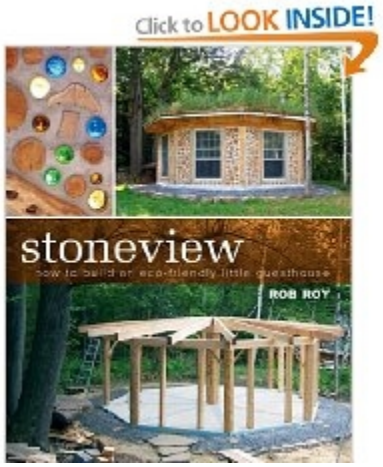
- **Get the rain away from the walls.** Broad eaves at the roof at least 12 inches deep will shed the water away from the house and keep your walls dry.
- **Practice makes perfect.** The arrangement of the cordwood is the key to creating beautiful walls. Practice on some test walls before embarking on the real thing. It will give you a chance to experiment with the patterns and get a feel for placing the walls.
- **Weave the corners of the cordwood walls together for added strength.** It takes a little longer but saves you money in the end. http://www.ecomii.com/building/cordwood

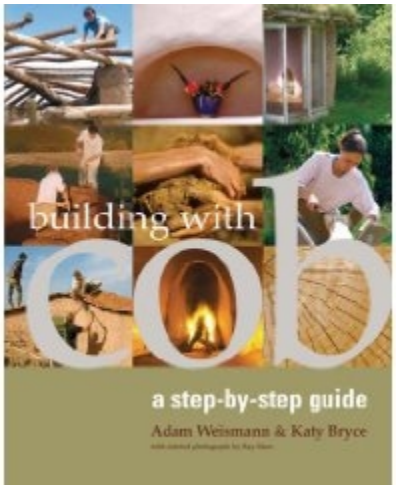
Recommended Videos:

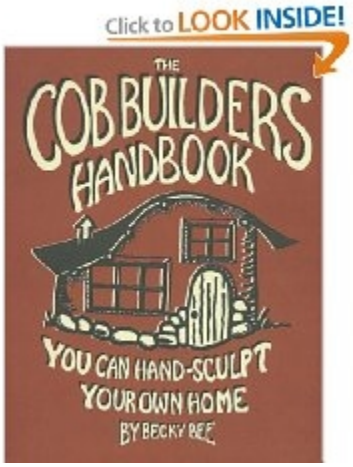
Recommended Books:

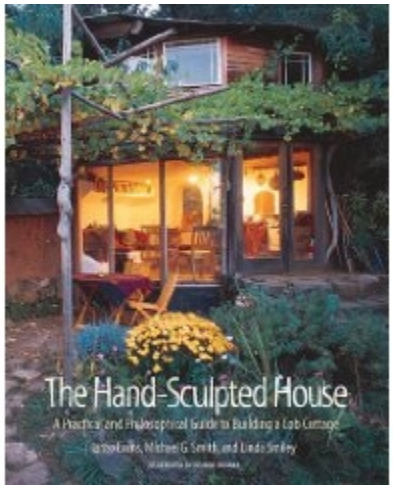


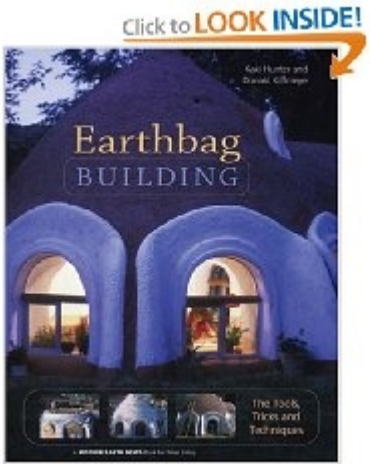


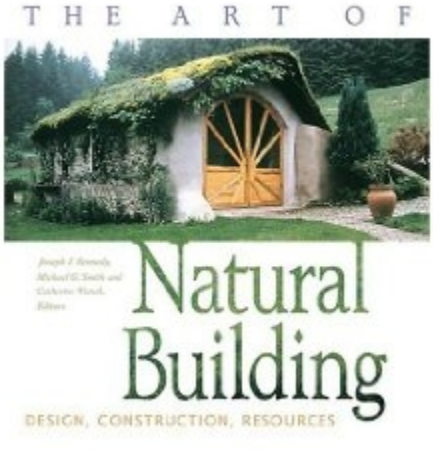


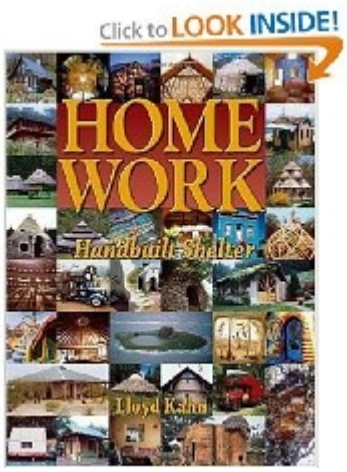












CHAPTER FOUR

Living in a round world!

What is a dome ?

“A geodesic dome is a spherical or partial-spherical shell structure or lattice shell based on a network of great circles (geodesics) lying on the surface of a sphere. The geodesics intersect to form triangular elements that have local triangular rigidity and also distribute the stress across the entire structure. When completed to form a complete sphere, it is known as a geodesic sphere.

Typically the design of a geodesic dome begins with an icosahedron inscribed in a sphere, tiling each triangular face with smaller triangles, then projecting the vertices of each tile to the sphere. The endpoints of the links of the completed sphere would then be the projected endpoints on the sphere's surface. If this is done exactly, each of the edges of the sub-triangles is slightly different lengths, so it would require a very large number of links of different sizes. To minimize the number of different sizes of links, various simplifications are made. The result is a compromise consisting of a pattern of triangles with their vertices lying approximately on the surface of the sphere. The edges of the triangles form approximate geodesic paths over the surface of the dome that distribute its weight.

Geodesic designs can be used to form any curved, enclosed space. Oddly-shaped designs would require calculating for and custom building of each individual strut, vertex or panel—resulting in potentially expensive construction. Because of the expense and complexity of design and fabrication of any geodesic dome, builders have tended to standardize using a few basic designs.” -http://en.wikipedia.org/wiki/Geodesic_dome

My first introduction to dome living was in the 70's when I took Karate from my cousin who used a dome for his Dojo studio.

I was impressed with the roominess and lack of corners and hard angles that a dome provides but was intimidated by the seemingly complex geometric angles and cuts necessary to build a dome. I have since learned that the construction is really very strait forward and easy to do if you have some good plans to work from. Domes make beautiful homes:

Pictures courtesy of http://www.wireless111.com/~domekits/earthshelteredd ome.htm

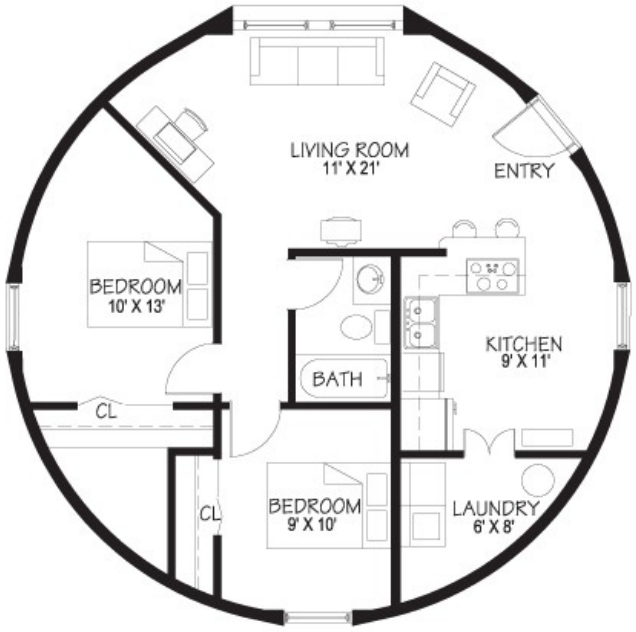
“The *Easy Domes* concept sets up for advantages in a very quick and easy assembling and raising of the building and its finish. On a concrete or timber basic it takes one day to raise and seal the construction which is made of quality plywood and 3x4 to 3x6" timber in pinewood.

All sections are premade and ready to assemble with bolts and nuts and the sealing of the edges with asphaltpaper or rubber. The climate shelter and finish out - and inside are also precutted plates / sections ready for mounting. “ -http://easydomes.com/

Harmonique Domespace

http://elitechoice.org/2007/10/31/elite-estate-eyes-enthusiasts-colorado-based-monolithic-dome-home/

Dome Interiors:



Advantages of a dome home

Geodesic domes provide an enclosed space free of structural supports. The basic structure can be erected quickly from lightweight pieces by a small crew. Domes as large as 50 meters have been constructed in the wilderness from rough materials without a crane. The dome is also aerodynamic, so it withstands considerable wind loads, such as those created by hurricanes. Solar heating is possible by placing an arc of windows across the dome: the more heating needed, the wider the arc should be, to encompass more of the year. Nowadays, there are many companies that sell both dome plans and frame material with instructions designed simply enough for owners to build themselves, and many do to make the net cost lower than standard construction homes. Construction techniques have improved based on real-world experience during the past several decades, and many newer dome homes can resolve some of the disadvantages that were true of the early dome homes.

Disadvantages of dome homes

As a housing system, the dome can have numerous disadvantages and problems.

The shape of a dome house makes it difficult to conform to code requirements for placement of sewer vents and chimneys. Off-the-shelf building materials (e.g., plywood, strand board) normally come in rectangular shapes and so much material may have to be scrapped after cutting rectangles down to triangles, thus increasing the cost of construction. Fire escapes are problematic; codes require them for larger structures, and they are expensive. Windows conforming to code can cost anywhere from 5 to 15 times as much as windows in conventional houses. Professional electrical wiring costs more because of increased labor time. Even owner-wired situations are costly, because more of certain materials are required for dome construction.

Air stratification and moisture distribution within a dome are unusual, and these conditions tend to quickly degrade wooden framing or interior paneling. Privacy is difficult to guarantee because a dome is difficult to partition satisfactorily. Sounds, smells, and even reflected light tend to be conveyed through the entire structure.

As with any curved shape, the dome produces wall areas that can be difficult to use and leaves some peripheral floor area with restricted use due to lack of headroom. This can leave a volume that may require heating – representing a cost in energy – but that cannot be lived in. Circular plan shapes lack the simple modularity provided by rectangles. Furnishers and fitters usually design with flat surfaces in mind, and so placing a standard sofa (for example) results in a crescent behind the sofa being wasted. This is best overcome by purpose-built fittings, though it adds to cost.

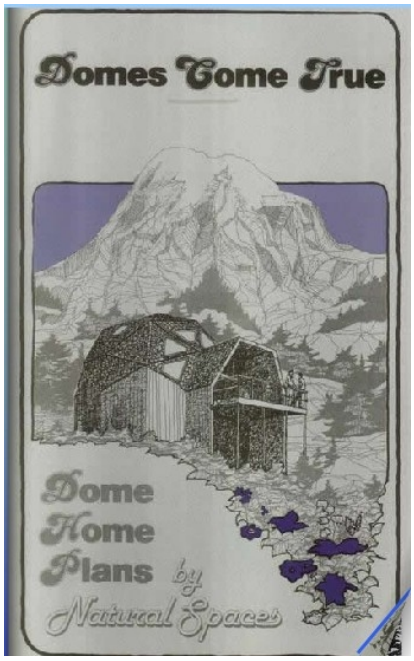
Dome builders using cut-board sheathing materials find it hard to seal domes against rain, because of their many seams. Also, these seams may be stressed because ordinary solar heat flexes the entire structure each day as the sun moves across the sky.

Dome Home Free Plans:

Natural spaces domes has two free to read online books on Dome Home Building.

Just click on the books and they will open in your web browser. The books and many numerous plans are available to purchase directly from their website:

http://www.naturalspacesdomes.com/dome_plans.htm



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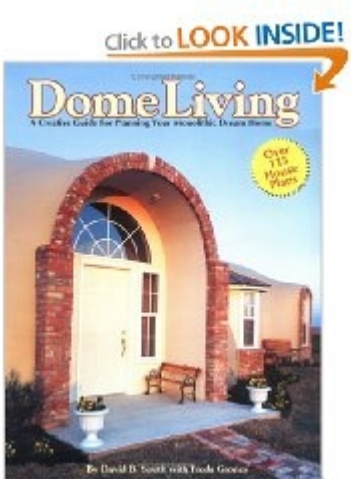
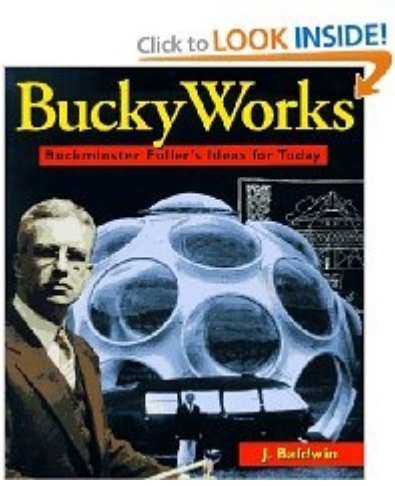
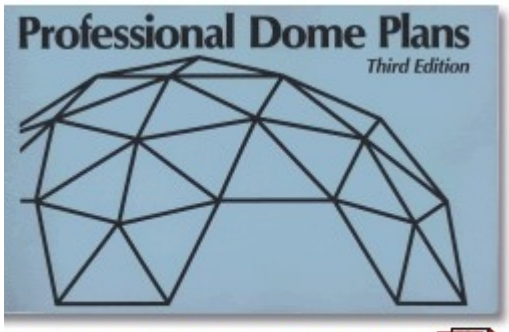






Click Here to download a PDF version of the book's full text and 7 sample drawings in 8 1/2" x 14" format.

Recommended Videos:

What is Yurt ?

“A **yurt** is a portable, felt-covered, wood lattice-framed dwelling structure traditionally used by nomads in the steppes of Central Asia. **“** -http://en.wikipedia.org/wiki/Yurt

Modern Yurts are more likely to use a waterproof canvas and may include a wood floor and partition walls but the basic structure is still the same.

Yurts are generally used as non-permanent housing and they can be moved fro place to place as the owner moves. However, some very nice yurts are used as permanent housing and have all the amenities of most modern homes.

Traditional yurts consist of a circular wooden frame carrying a felt cover. The felt is made from the wool of the flocks of sheep that accompany the pastoralists. The timber to make the external structure is not to be found on the treeless steppes, and must be obtained by trade.

Mongolian yurt: starting with walls and door

Mongolian yurt: starting to place roof poles

Mongolian yurt: with roof poles in place

Mongolian yurt: placing the thin inner cover on the roof

Mongolian yurt: adding felt cover

Mongolian yurt: adding the outer cover

Mongolian yurt: tying off the covers and completing the structure

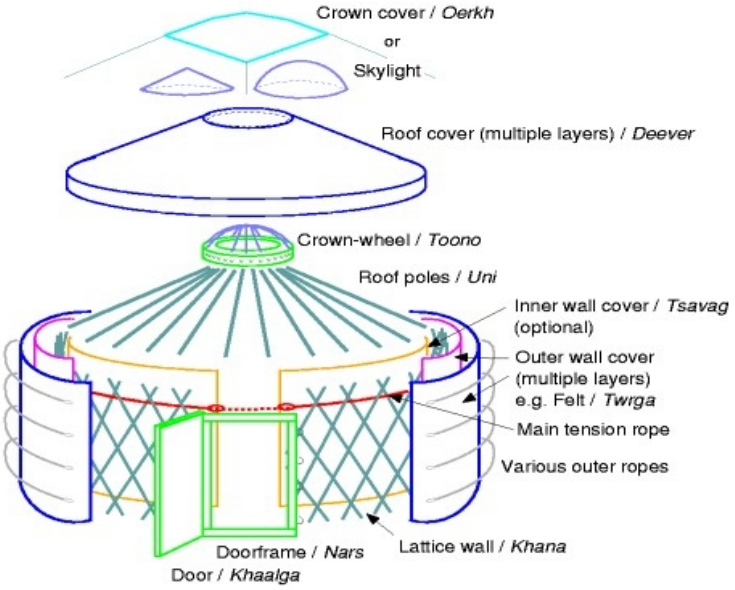
This is a traditional Mongolian Yurt that resides in th US. Note the chimneys in yurts. In Mongolia wood is scarce but animal dung burns quite well. A small home like this can be heated with a very small dung, wood, or propane heater.

A yurt interior can be as simple or elegant as you want.
This one is used as a Pilates studio.

A nice wood finished Yurt interior

A simple Yurt interior compete with kitchen, wood stove and bedroom.
This is one of the guest Yurts at Trellyn Woodland Campsite.

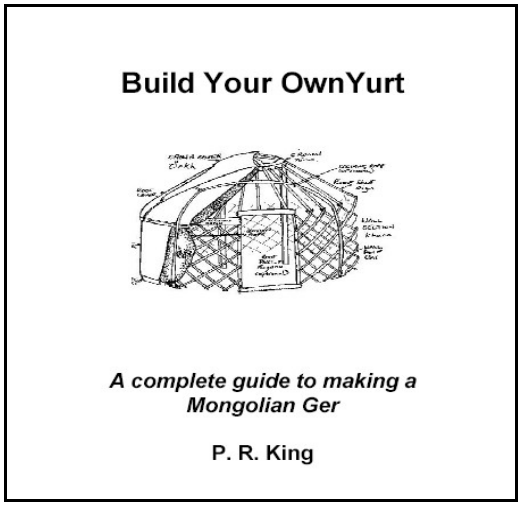
How to build a Yurt:



http://www.simplydifferently.org/Yurt

DEC n' NRT Build a YURT
Waitsfield Vermont, 2003
Our yurt building story.
Yurt Raising 1
We get started in the spring.
On the Road
We sew our roof in Lowell.

DEC n' NRT Build a YURTWaitsfield Vermont, 2003Our yurt building story.

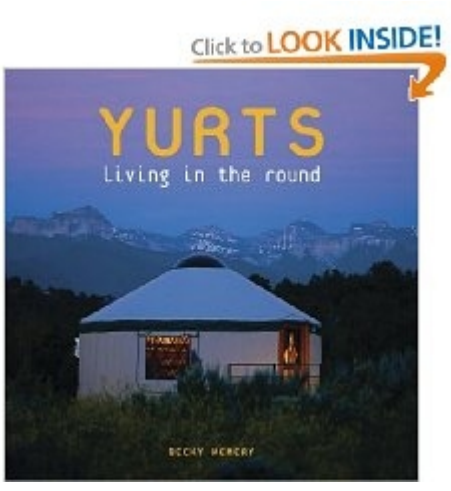


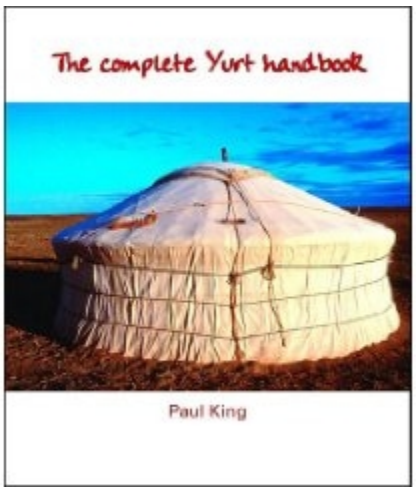
This is a FREE pdf download for complete Yurt building instructions available from:

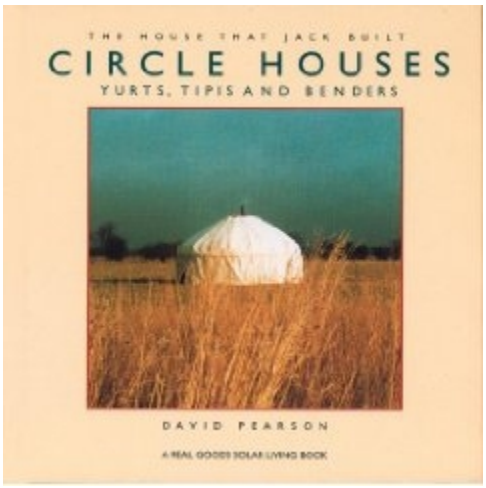
http://www.woodlandyurts.co.uk/Yurt_Facts/Build_your_own_yurt.pdf

Yurt Kit Companies:

Recommended Books:







Recommended Videos:

Yurt Village Music - Air on a G String Swanage Dorset

Setting up a Colorado Yurt

Time lapse of a Yurt Build

The Hogan:

A hogan is the primary traditional home of the Navajo people. Other traditional structures include the summer shelter, the underground home, and the sweat house. It is usually round and cone shaped, but now they make them square, with the door facing the east to welcome the rising sun for good wealth and fortune. http://en.wikipedia.org/wiki/Hogan

The Tipi:

A **tipi** (also **te(e)pee**) is a conical tent traditionally made of animal skins or birch bark and popularized by Native Americans of the Great Plains. Tipis are stereotypically associated with Native Americans in general but Native Americans from places other than the Great Plains used different types of dwellings. The term ″wigwam" (a domed structure) is sometimes incorrectly used to refer to a tipi.

The tipi was durable, provided warmth and comfort in winter, was dry during heavy rains, and was cool in the heat of summer. Tipis could be disassembled and packed away quickly when a tribe decided to move and could be reconstructed quickly when the tribe settled in a new area. This portability was important to Plains Indians with their nomadic lifestyle.

Modern tipi covers are usually made of canvas. Contemporary users of tipis include historical reenactors, back-to-the-land devotees, and Native American families attending powwows or encampments who wish to preserve and pass on a part of their heritage and tradition. -

http://en.wikipedia.org/wiki/Tipi

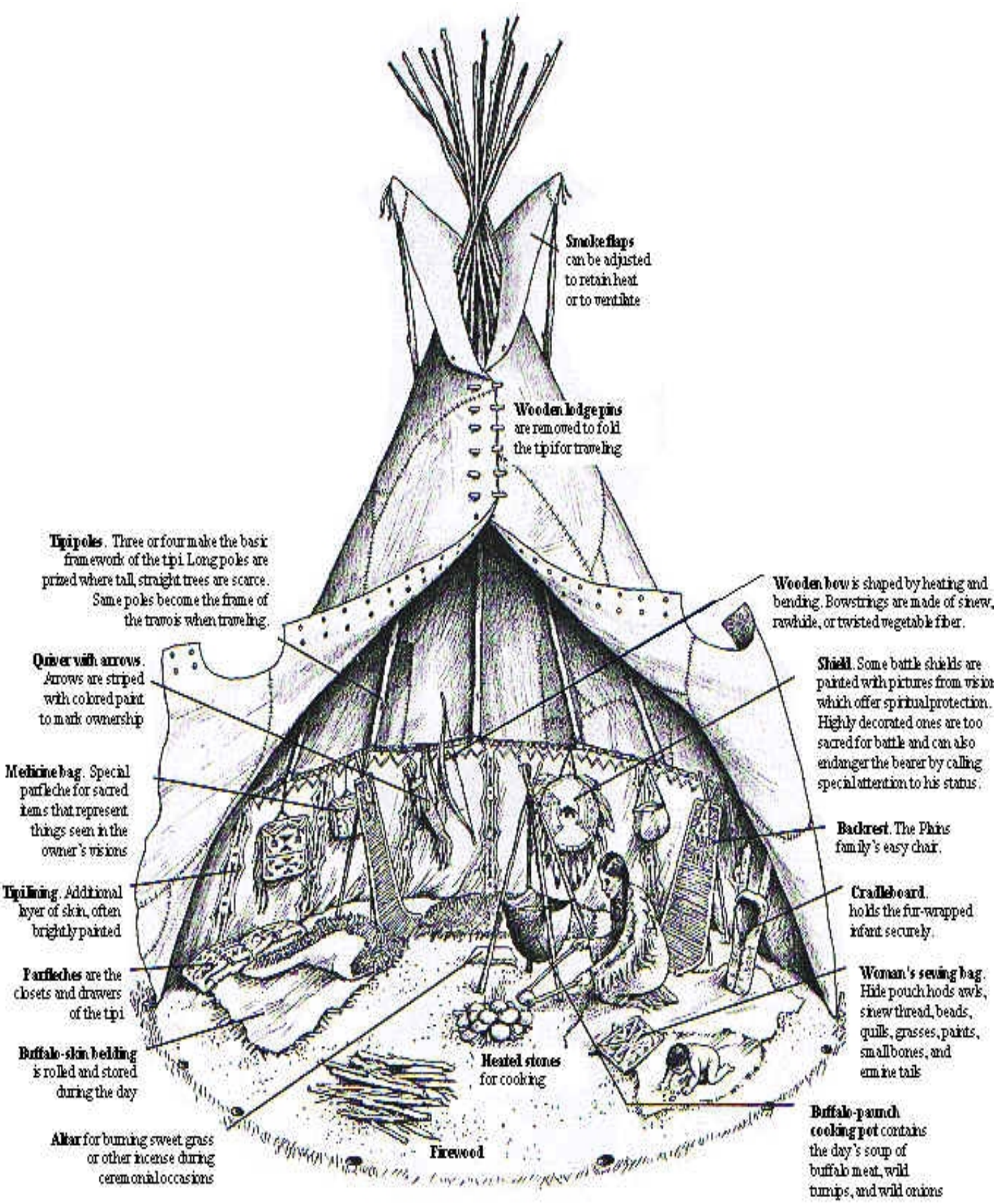
Photograph of Crow lodge interior, 1907, showing the poles and outer skin at the top, the inner lining and bedding. The lashing rope is tied off to a wooden stake at the bottom of the photograph. Clothing is suspended on a line tied between two of the tipi poles

Structure:

A tipi consists of four elements: a set of ten to twenty poles; a cover historically used with bison skins; an optional inner canvas or skin lining; and a canvas or skin door. There may also be an optional partial ceiling. This was called an ozan; however, it is now found that the word ozan refers to the liner.

Ropes and pegs are required to bind the poles, close the cover, attach the lining and door, and anchor the resulting structure to the ground. Tipis are distinguished from other tents by two crucial innovations: the opening at the top and the smoke flaps, which allow the dweller to cook and heat themselves with an open fire, and the lining that is primarily used in the winter, which insulates while providing a source of fresh air to fire and dwellers. Tipis are designed to be easily set up to allow camps to be moved to follow game migrations, especially the bison. The long poles could be used to construct a dog- or later horse-pulled travois.

Tipi covers are made by sewing together strips of canvas or hide and cutting out a semicircular shape from the resulting surface. Trimming this shape yields a door and the smoke flaps that allow the dwellers to control the chimney effect to expel smoke from their fires. Old style traditional linings were hides, blankets, and rectangular pieces of cloth hanging about four to five feet above the ground tied to the poles or a rope. Today's modern lining is the most difficult element to measure, since it consists of trapezoid-shaped strips of canvas assembled to form the shape of a truncated cone. The poles, made of peeled, polished and dried tapering saplings, are cut to measure about six feet more than the radius of the cover.


Smoke flaps can be adjusted to retain heat or to ventilate
Wooden lodgepins are removed to fold the tipi for traveling
Tipi poles. Three or four make the basic framework of the tipi. Long poles are prized where tall, straight trees are scarce. Same poles become the frame of the travois when traveling.
Wooden bow is shaped by heating and bending. Bowstrings are made of sinew, rawhide, or twisted vegetable fiber.
Quiver with arrows. Arrows are striped with colored paint to mark ownership
Shield. Some battle shields are painted with pictures from vision which offer spiritual protection. Highly decorated ones are too sacred for battle and can also endanger the bearer by calling special attention to his status.
Medicine bag. Special parfleche for sacred items that represent things seen in the owner's visions
Backrest. The Plains family's easy chair.
Tipi lining. Additional layer of skin, often brightly painted
Cradleboard. holds the fur-wrapped infant securely.
Parfleches are the closets and drawers of the tipi
Woman's sewing bag. Hide pouch holds awls, sinew thread, beads, quills, grasses, paints, small bones, and ermine tails
Buffalo-skin bedding is rolled and stored during the day
Heated stones for cooking
Buffalo-paunch cooking pot contains the day's soup of buffalo meat, wild turnips, and wild onions
Altar for burning sweet grass or other incense during ceremonial occasions
Firewood

Picture courtesy of http://www.ossahatchee.org/tipi.htm

Construction:

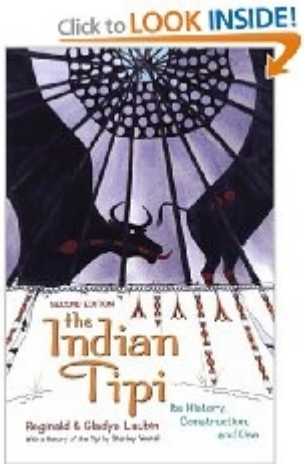
The construction of a tipi starts with tying together three of the poles at the skin's radius from their bases using a tripod lashing. One end of this lashing rope is left dangling from the tie-point, long enough to reach the base of the poles. These tripod poles are stood upright, with their unfastened ends spaced apart on the ground to form a triangle, each pole's base the skin's radius from its neighbors. A dozen more long poles are laid onto the three primary poles. Their upper ends rest on the lashing of the first three, and the lower ends are evenly spaced to form a circle on the ground which includes the original three poles. The lashing rope is then walked around the whole structure three times and pulled tight. This ties the placed poles to the tripod at the crown of the tipi. The canvas skin is tied to another pole, lifted up and the top of the pole is rested where all the poles meet. The skin is pulled around the pole framework. The overlap seam is closed with wooden lacing pins which are thin sticks about 10 inches long with one or both ends tapered. Sometimes a door is attached to one of the bottom lacing pins. In old tipis of hide or early cloth, the door was where the two sides came together in the front. A blanket, hide or cloth door was put over the opening to secure the entrance.

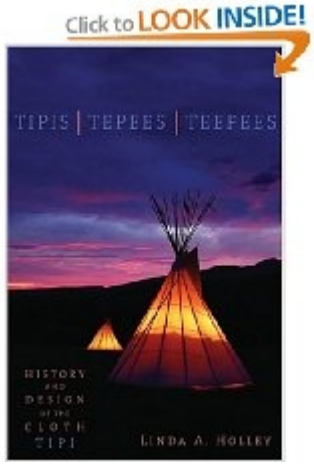
The base of the skin is pegged to the ground. Traditionally pegs were placed in slits at the bottom of the cover. As canvas or cloth came into use loops were sewn into the bottom or, in an emergency smooth pebbles were pushed into the cloth and a cord tied between the bulge of cloth and a wooden peg in the ground. A gap can be allowed at ground level for airflow in warm seasons and the base is completely closed to the ground in cooler times. The bases of the non-tripod poles are moved in or out to tension the skin. Inside the tipi, a cord is wrapped from pole to pole above head height. An inner lining can be suspended from this cord and pushed back on the ground near the inside base of the poles. Bedding and personal items are pushed against the liner to keep it in place. The inner lining acts as a heat insulator and draft and pest excluder. An interior awning which prevents rain drops hitting bedding can be suspended at the top of the lining.-http://en.wikipedia.org/wiki/Tipi

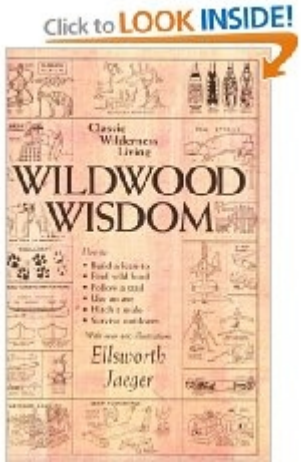
The tipi poles are carried by cart or truck to the site. In the past, poles would be dragged by horse and travois. Our tipis have a special number of poles in the framework. We alternate from each side as poles continue to be added. Big Tobacco's owl tipi at the Siksika Sun Dance, August 1961 -http://jafproject.net/index.php?id=A2004111

http://www.funcampco.ca/Tipiconstruction.htm

Recommended Books:







Recommended Videos:

Tricks for Pitching a Large Tipi

Teepee Set Up (part 1 of 2)

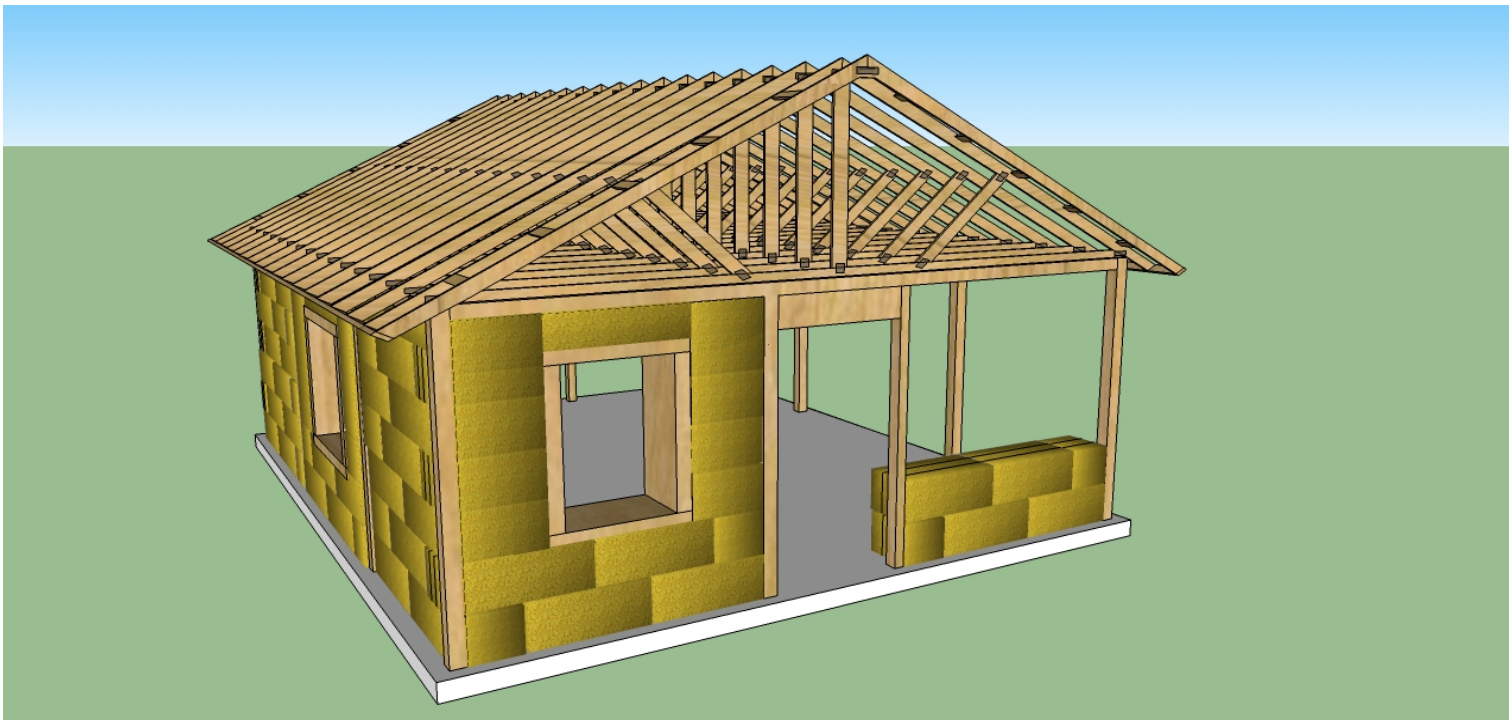
DWR Teepee Instructional (part 2)

CHAPTER FIVE

Straw Bale Homes

What is a straw-bale home ?

Straw-bale construction is a building method that uses bales of straw (commonly wheat, rice, rye and oats straw) as structural elements, insulation, or both. This construction method is commonly used in natural building or "green" construction projects. Straw-bale construction has some advantages over conventional building systems because of the renewable nature of straw, its cost, easy availability, and its high insulation value.



20 X 24 Straw Bale Post and Beam Construction

This is a typical 20 X 24 straw bale home using 4x4 post and beam construction. The roof rests on the post and beam frame and not on the straw bales for added strength. The straw bales are basically used as insulation.

You can download this 3D sketchup file from my website and play around with it to change its size, materials and finish it anyway you want.

You will need Google Sketchup available for free here: Google Sketchup Download

The 3D straw bale house file is here: Downoad

Straw bale homes can be built in many style and unless you look at the thickness of the walls you would probably never be able to tell a straw bale house from a conventional house.

Basic straw bale building techniques

Strawbale buildings can be generally characterized as either load-bearing or non-load-bearing. In a load-bearing straw house the weight of the roof is supported by the bales themselves without any other framework. Non-load-bearing straw buildings have a frame made of wood or other material and use the straw bales to fill in the walls and create insulation.

Load-bearing buildings are generally limited to one story and are often small. If designed correctly they can require less wood than non-load-bearing buildings.

Non-load-bearing buildings often use a post and beam frame with straw bales as infill to create the walls. They can be any size and shape and have multiple stories. One advantage over load-bearing is that the roof can be finished before installing the straw bales which makes it easier to keep them dry (a critical factor in straw bale construction). Another advantage is being more easy to get building permits for (at DR we have no building codes so do not need building permits).

In our ten years of experience building with straw bales we have certainly learned a few things. Some of them might be useful to you:

- **Buying Good Straw Bales** - The first step in having a good straw bale house is to pay serious attention to the quality of your straw bales. The ideal bale is made of densely packed, long straw fibers. It is kept clean and dry. It is ideally tied with poly-pro twine or as a secondary option metal wire (metal can rust in some situations). It is best to have your bales custom made by the farmer, having them combine the grain just below the seed head, then mowing the straw near the ground (to get the longest fibers) and then baling the bales as tight as possible without bursting. If this is not possible look for bales that are not squishy, do not easily deform, and are heavy (but dry).

- **Compression** - For load-bearing buildings pre-compression seems like the way to go (from our experience of not doing so). You'll also find compression to be useful in non-load bearing applications, by sizing the wall cavity to 1 inch less than the expected height of the bales. You can compress the straw bales using a piece of plywood and car jacks and a piece of plastic to help slide the bale. Having the bales compressed adds strength to the wall and keeps bales from slipping against each other.

- **Re-tying and Modifying Straw Bales** - Bales can be retied to any length using a bale needle. It is worth some effort to design a home to minimize retying but it is not so much effort that major design changes need to be made. Straw bales can also be modified using a chain saw to notch around framing members, electrical boxes, etc. Bales can have one string re-tied short so the bales can be curved around windows. Niches and other sculptural features can be added with a chain saw after the wall is in place.

- **Light-clay-straw for filling voids** - Straw bale walls will inevitably have voids that need filling, especially at the corners of bales. Stuff deep holes with dry straw at first and then start adding clay-slip to your straw so that the final stuff has a serious amount of clay. Work this clay straw into the cracks between bales to secure it into the wall. It will dry to a hard firm surface that can take plaster beautifully.

- **Big Overhangs** - It can't be said enough that big overhangs will help protect your strawbale wall. If you want to do exterior plaster with earth this is essential. A two foot overhang at 8 feet high is a minimum for a place with frequent driving rainstorms. Be wary of gabled roofs that leave ends of buildings with an overhang 16 or 20 feet

high that will provide almost no wall protection. Consider porches, trellises, and other landscaping to block rain and break up wind. - Info Courtesy of Dancing Rabbit: http://www.dancingrabbit.org/building/straw_bale.php

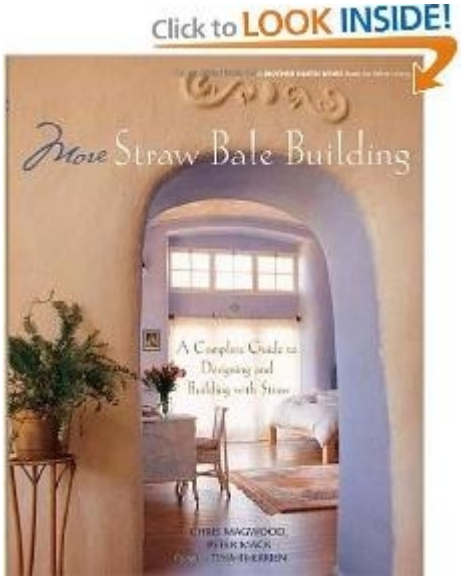
- **Big window sills** - Water running off of windows can damage plaster below the windows. By having a window sill that sheds water away from the building plaster can be preserved and leaks prevented.
- **Passive Solar Design** - When trying to incorporate passive solar heating it can be difficult with a load-bearing straw bale home to get enough window space on the south side of the building without losing structural stability. One can have posts and a beam for the south side alone but you must then plan for bale compression on the other sides.
- **Earth Contact** - In our climate, insulation is great but direct contact with the earth is what helps keep a straw bale home cool in the summer and easier to heat in the winter. See our information on Earthen Floors.
- **Burlap to Connect Wood to Straw** - One of the most serious plaster problem area is the interface between the straw and other materials such as wood. If the wood is to be plastered over we have had great success using burlap. Many straw bale books suggest metal lathe, chicken wire or stucco netting. Unless your are doing machine applied plaster avoid these at all costs! They are a pain to plaster around. You can take the burlap and staple it to the wood using a staple gun, overlapping it 3-4 inches onto the straw. Then coat it in clay slip and embed it in the infill coat of plaster. The burlap is an incredibly strong network of fibers that prevents the plaster from cracking at this juncture.
- **Prevent Infiltration at the Edges** - The effectiveness of insulation is greatly diminished if air can infiltrate the house. This often happens at the edges of doors, windows, ceilings, foundations, and wall sections. Careful plastering at these points can help but shrinkage occurs with drying and temperature changes and cracks can develop. Caulk can help but the ideal thing is to overlap plaster onto the rough framing and right up to the exposed trim -Info courtesy of Dancing Rabbit: http://www.dancingrabbit.org/building/straw_bale.php

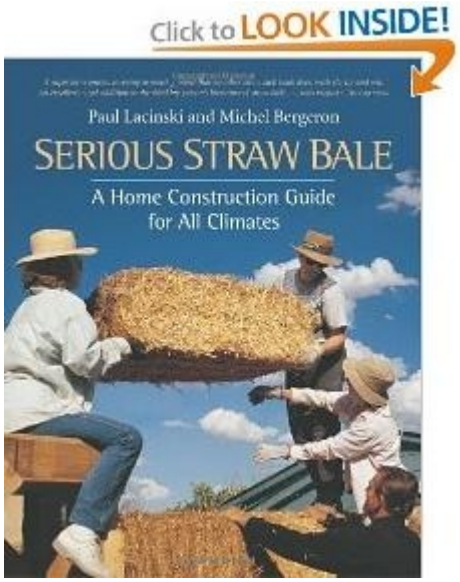
Videos for Straw Bale Construction

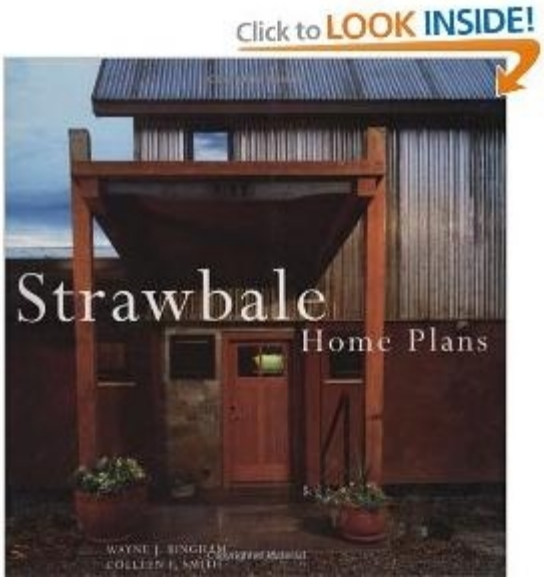
http://www.youtube.com/watch?v=LZABqaEsrLM

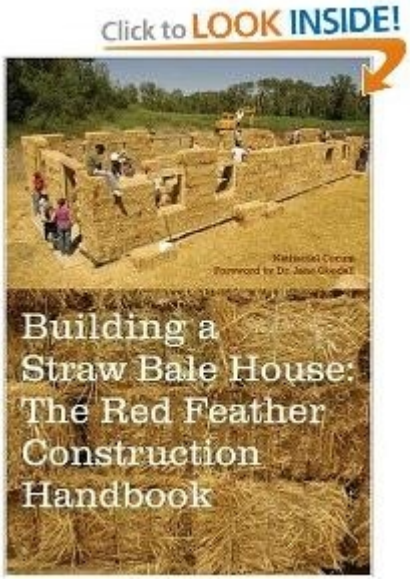
http://www.youtube.com/watch?v=XgbORHvveTY

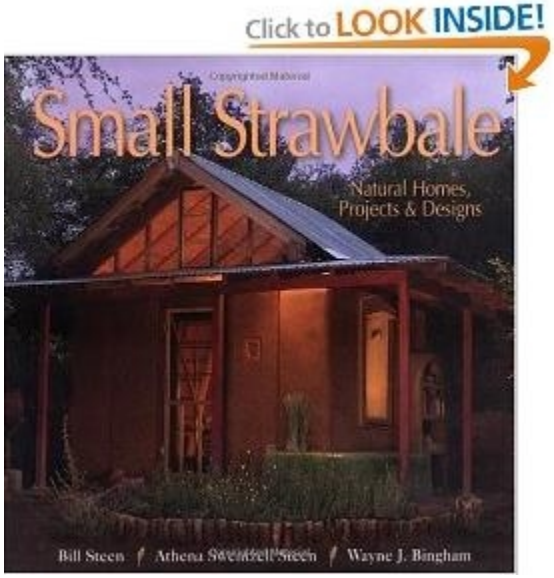
Books on Straw Building

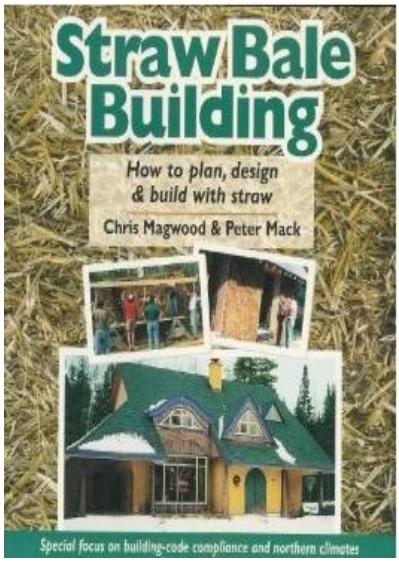








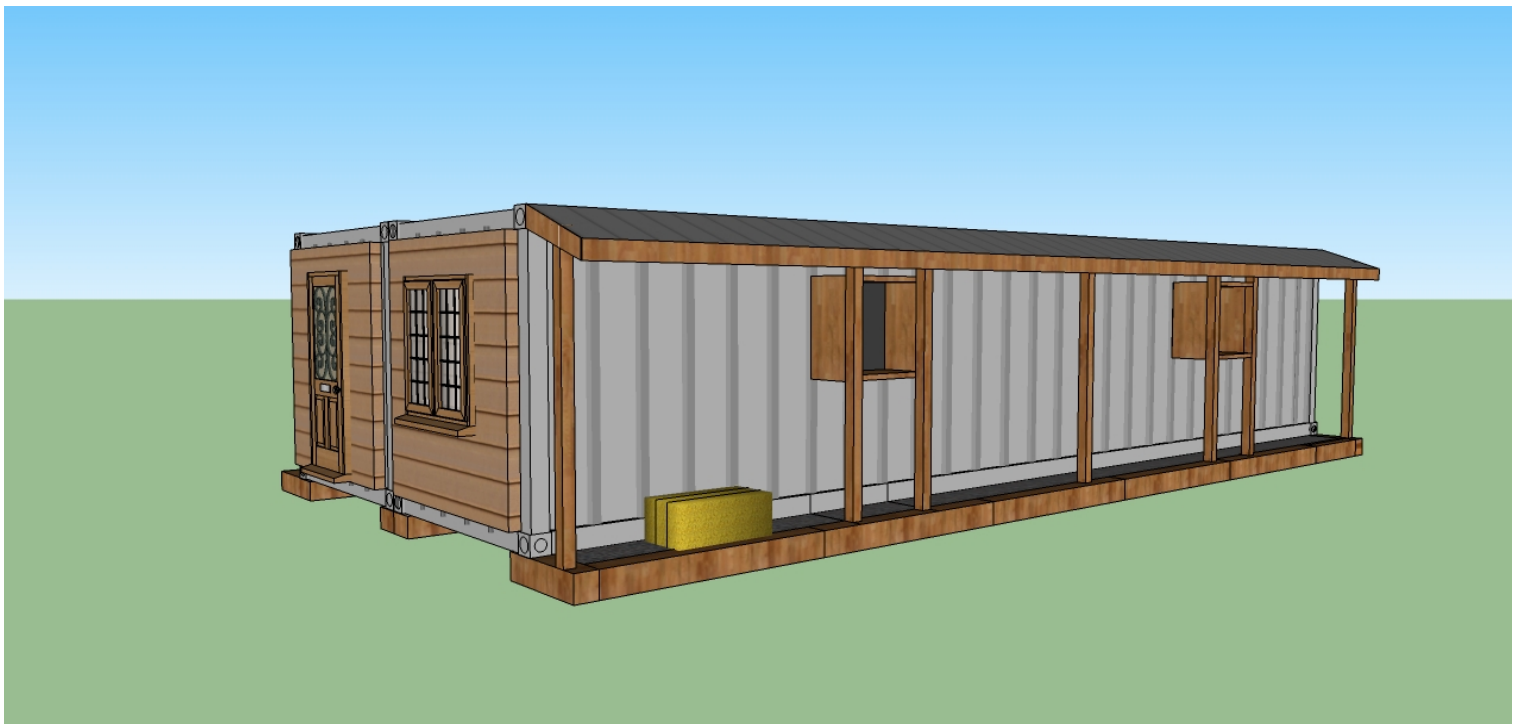



Straw Bale Building
How to plan, design & build with straw
Chris Magwood & Peter Mack
Special focus on building-code compliance and northern climates

Shipping Container Homes

There are millions of steel cargo containers used around the world to haul cargo by ship, train and truck and after awhile they are retired and usually end up junked for scrap. These can be purchased relatively inexpensively and made into beautiful homes that are superior to wood homes for safety in earthquake and tornado country.

Here are my plans for a straw bale and cargo container home:



The shipping container can be placed on a cement pad or footing or for a less expensive solution it can be placed on railroad ties anchored with rebar. The space inside the ties is filled with pea gravel which provides a drain base and air flow for the straw bales and prevents rot.

Cut out windows using a sawzall and frame with lumber. 4X4s are used to hold up the partial roof which is covered in metal roofing. The roof must extend at least a foot past the bales to prevent water penetration from rain and snow.

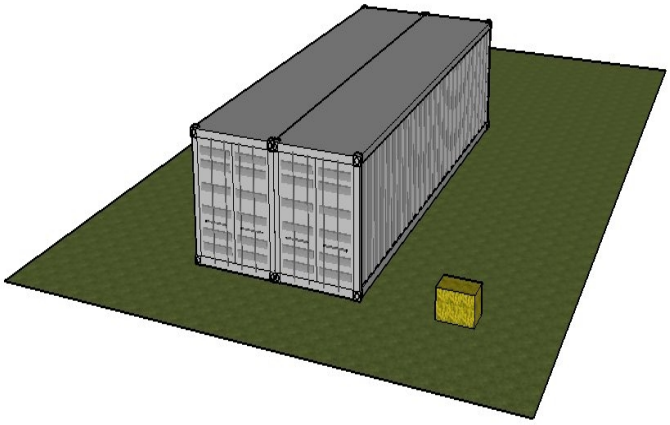
Paint the top of the containers white to reflect away sunshine and heat. A roof vent turbine can also be installed.

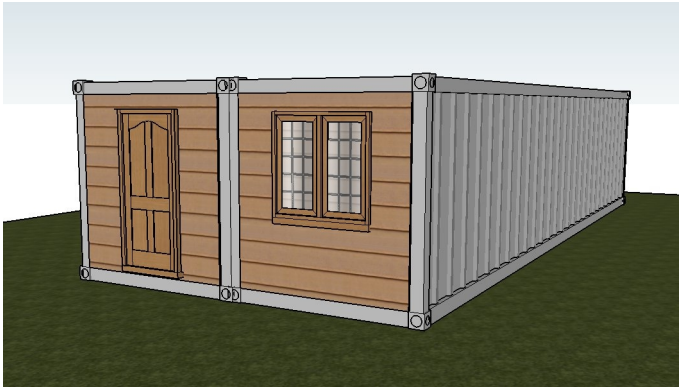
The metal doors are removed and a 2x4 insulated frame is installed to support doors and windows. On the back end of the container you can cut out door and window openings with the sawzall.

Only the ceiling and end walls need insulation and this can be done with 4" sheets of foamcore glued to the container walls. Drywall can be applied by gluing it to foamcore.

Interior rooms can be expanded by cutting away the middle container walls with a sawzall. Two 8x40

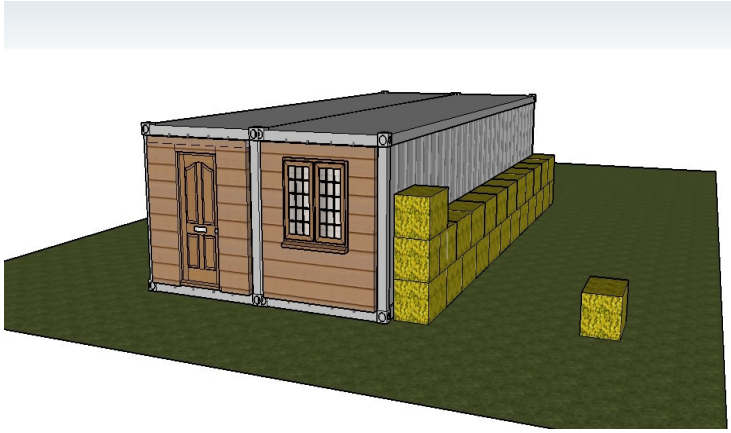
foot containers will give you approximately 570 sqft of living space.

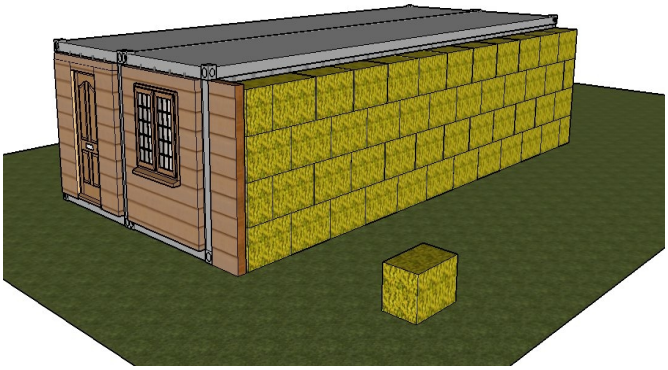




The cargo container should be placed on a cement foundation or a bed of 6" gravel that extends 3' around side walls for drainage. Straw bales should not be placed directly on the ground.

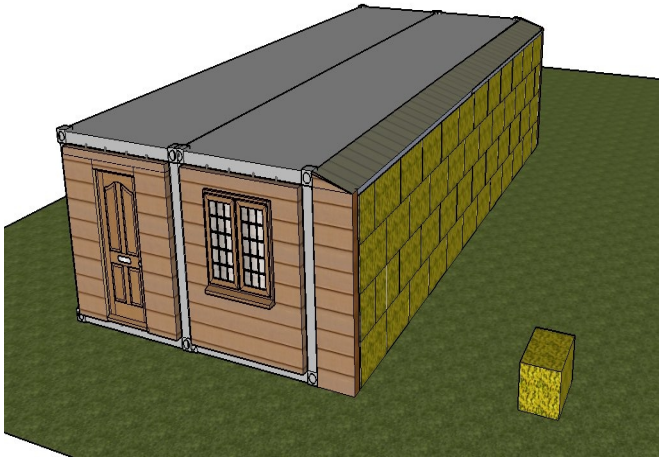
Remove the steel doors and build a 2x4 insulated frame to hold a door and window.

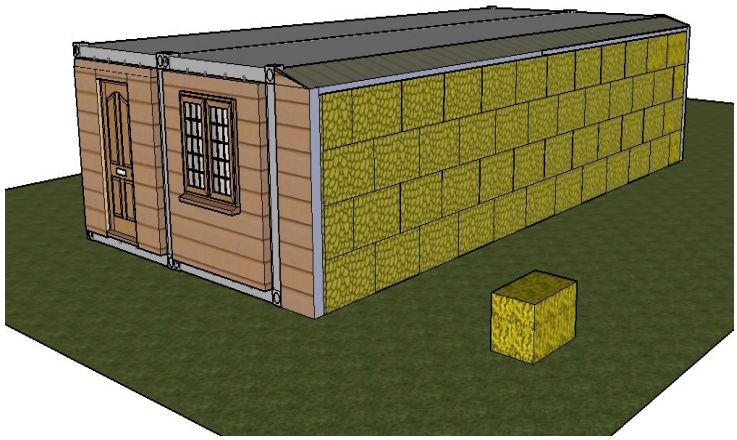




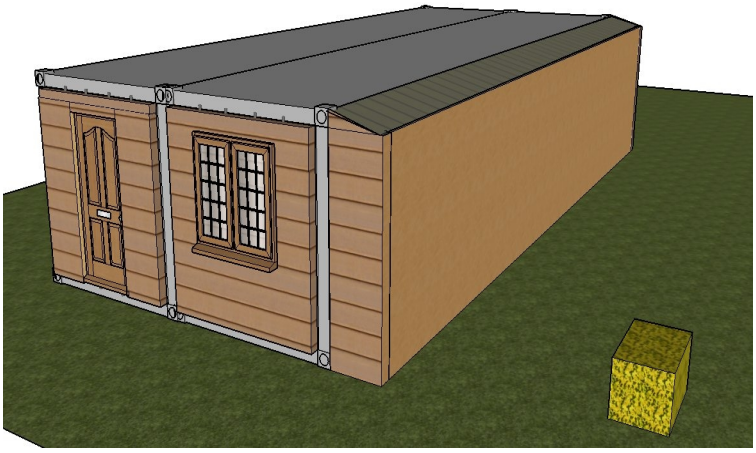
Straw bales are stacked against the side walls and tied and pinned in place with rebar. Fill the gap between the bales and container wall by loosely pouring in pea gravel. Build a 2x4 frame that extends past the ends of the bales that will support the roof overhang.

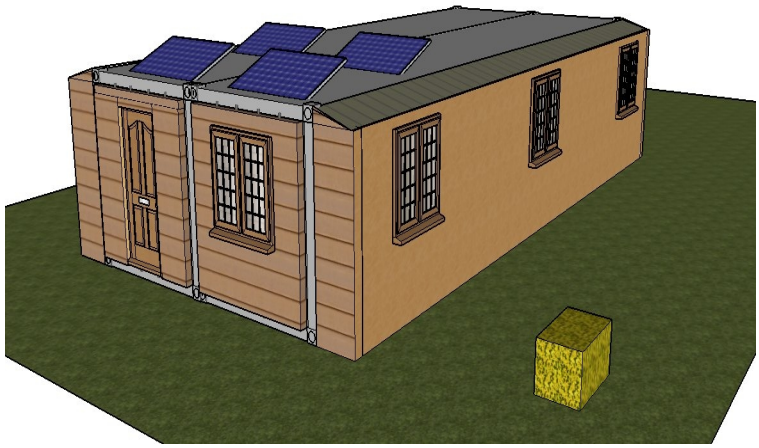
Here is a closeup of the railroad tie footing filled with pea gravel. The ties are pinned in place by driving rebar through the tie into the ground.



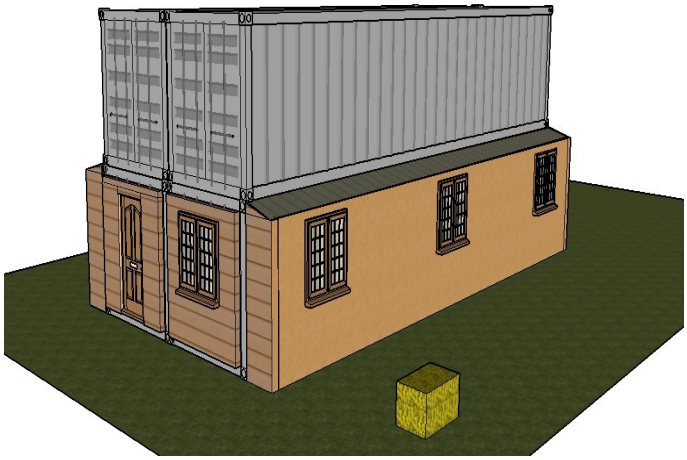


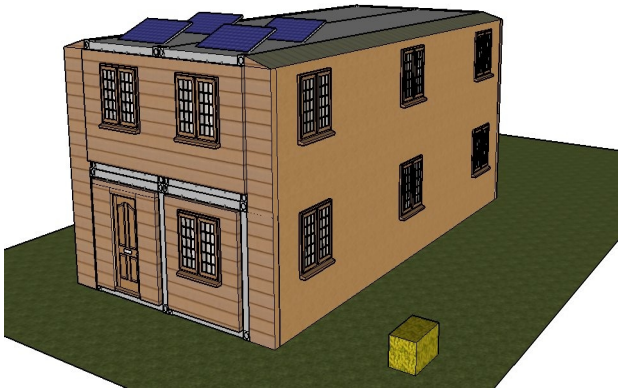
The roof over the straw bales is a 2x4 frame covered in metal roofing. The straw bale front is wrapped in chicken wire that will give you a nice surface to stucco.





Stucco is applied to the outside of the bales. Before you stucco cut out and frame in any windows you want in the sides of the cargo container. Repeat for both sides of the cargo container.





Cargo container are designed to be stacked so you could make this a two story home if desired.

Straw Bale Cargo Container Home

Nice single wide container home in warmer climate. Note: it is set on railroad ties

What Is A *Shipping Container Home*?

A shipping container home is just as it sounds, a home made fabricated from shipping containers. The average shipping container is built from weathered steel, and are generally eight feet wide, eight feet tall and can be purchased in either a 20 foot or 40 foot lengths.

Container Homes are comprised of either one or many shipping containers stacked in many different designs to make a stylish, affordable, and green home.

Buying A Shipping Container

Shipping containers aren't hard to find. If you live near a coastal area check around the local ports. Even if you live in a rural land-locked region there is a high probability that there are some shipping containers sitting around close by. Prices average from $1000 to $2000 for a decent quality used container 40 feet in length. Delivery is seldom a problem because they are made to be transported. Most trucking companies will haul them for about $2/ mile.

Building A Shipping Container Home

Building a container home is no different than other modular construction. The largest exception is working with a metal structure rather than wood. To modify the basic structure you will need metal working tools such as a welders, torches, cutters and grinders. Interior construction shouldn't be a lot different than standard home remodeling. A foundation or concrete slab will keep your home stable and provide a solid base that will keep your container home off of the ground and relatively dry. Remember to put your plumbing in place before you set your container.

The addition of a slanted roof on the top level is always a good idea. Keeping setting water off of your container will prevent premature corrosion that could otherwise take place. Ultimately the design of your home will be up to you, local building codes, and your skills and imagination

Affordable And Green

There are many reasons to consider a shipping container home. Currently there are seven hundred thousand idle shipping containers in the U.S. alone that are literally piling up in the junkyards.

Shipping Containers are extremely affordable and because they are made from weathered steel, are structurally very strong. Shipping Containers are also built to standard sizes so they could be stacked on boats easily and snap together like legos. Building a house is as easy as snapping them together.

Hurricane And Earthquake Proof

In addition to Container Homes being green and affordable, they are also very resilient. Because of their steel structure they are able to withstand Hurricanes and Earthquakes better than most homes built today.

Homes built from brick will crumble in the event of an earthquake and structures built from wood are commonly destroyed in a tornados or hurricanes. Storage containers are built to be stacked. Their welded construction makes them water tight almost indestructible.

Stylish

I know what you're thinking, what kind of house am I supposed to make out of a Storage Container? Actually, there are many different designs you can make. Not only that, you can make the interior very well insulated and just as spacious a the current home you may live in.

Building a home out of Storage Containers gives you so much flexibility that companies are actually building transportable homes that can be moved and set up within 24 hours. A shipping container home is an easy way to build an indestructible stylish home.

Building With Containers

While shipping containers provide quick and affordable housing there is more than just dropping a container where you will and inhabiting it. The list below are some of the areas that require consideration when building a shipping container home.

Transportation	**The Foundation**
Windows /Doors	**Electrical**
Heating – A/C	**Plumbing**
Insulation	**Roofing**

Transporting Storage Containers

The first thing you need to address when you decide you are going to build a shipping container home is transporting and finally arranging them into the desired configuration.

The great thing about shipping containers is that they are made with easy transportation as a design consideration. Stacking containers horizontally is also something that they were made for. Think of them as giant legos!

Because of the abundance of these containers, and the fact they will fit on to a standard size semi, most companies will ship them to your location for you for a fee and place them in the desired location. Remember to factor in this when purchasing your containers.

Stacking shipping containers is usually accomplished with a small crane or large forklift. Renting the equipment for placement is worth the money. It also saves you a lot of time without risking injury or damage to the structure.

The Foundation

Even though Storage Containers are close to indestructible,a good foundation can give your structure a lot of advantages.. A foundation will keep unwanted water from corroding the steel structure over time. A good foundation is usually embedded a meter or so in to the soil. This will prevent the base of your house from sliding because the weight will be shifted from the walls to the soil or bedrock below. A foundation can range from a solid gravel/rock bed to a fully excavated basement.

Windows and Doors

Windows and doors can be added to your container structure with the help of a good cutting torch or metal hot saw. Most windows and doors that are purchase at your local home improvement center will give you the necessary dimensions for the opening.

The major difference in installing windows and doors on this type of a structure will be compensation for wall thickness with your trim. Most doors and windows are designed to fit into a wall that is equal in width to a 2x4 and two pieces of sheet rock on either side, or about 4 inches. The wall of a container is only about 2 inches wide, therefore you will have to "build out" your trim about 2 inches.

If your insulation is on the inside you will want to bring your window/door flush to the outside. If you insulate on the outside of the container you will want to bring your window flush to the inside wall.

Running Utility Services

Unless you decide to frame in the walls of your container home with 2x4s or steel studs you will be presented with an immediate problem - no space to run your electrical wiring, heating/cooling ductwork, and water or drain pipes. Assuming that the width of your container is 8 feet, if you decide to frame in the inner walls you will reduce the width of your living space by almost 8 inches (both sides). That's a lot of room in an already narrow room structure.

Rather than using the wall space for this task why not use the floor? Most containers are in the neighborhood of eight feet in height. You can raise the floor by a foot and still have a standard ceiling height. By building access channels in the raised floor you can also save yourself some grief when those water pipes, wires, and ducts need maintenance.

Insulation

The amount of insulation that you install is a matter of personal preference. Once again you have the option of placing the insulation on the inside or the outside of your walls. Insulation can vary from classic sheet insulation covered with siding to spray on polymers that will give your container home a "rock-like" look.

Roofing

The top of a shipping container is flat - not an advantage when designing a roof. Not only does a roof collect water, it also collects heat and light. All of these resources and their interaction with your home should be considered when deciding on a roof. Consider using your roof as a water collector or solar water heater.

Adding a slant to your roof doesn't have to be an expensive process. Adding a welded pipe frame covered with a sheet metal roof much like utility buildings or modern barns makes and attractive and sturdy roof.

Converting shipping containers to a personal living space can be a great adventure in creativity and perhaps one of the most affordable housing options available today.

Info courtesy of: http://www.containerhomeguide.com/BuildingContainer.html

Shipping Container Home Videos:

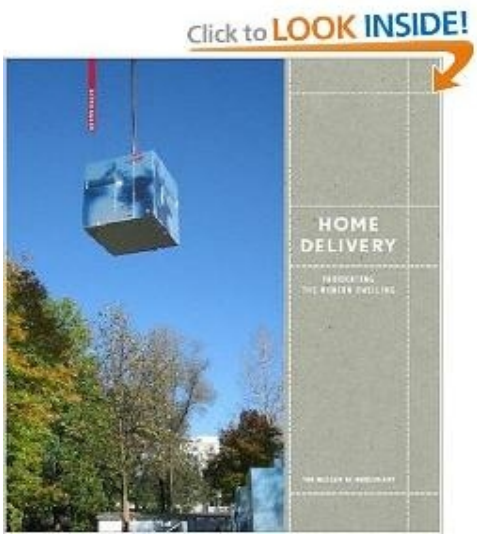
PART 1 Step by step of Shipping Container Home ...
by jim08816cr
54,838 views

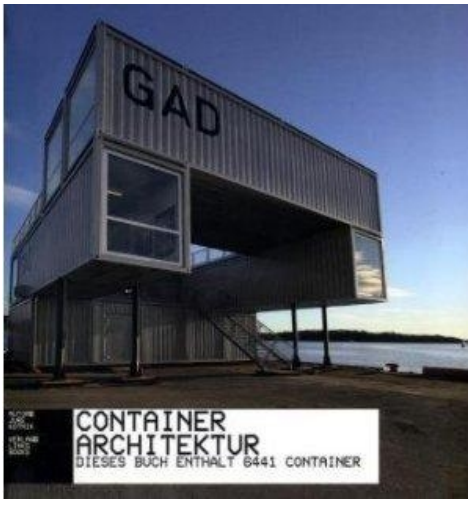
http://www.youtube.com/watch?v=eOU8c12Gecw

Off Grid Shipping Container House
by jhadley40
289,235 views

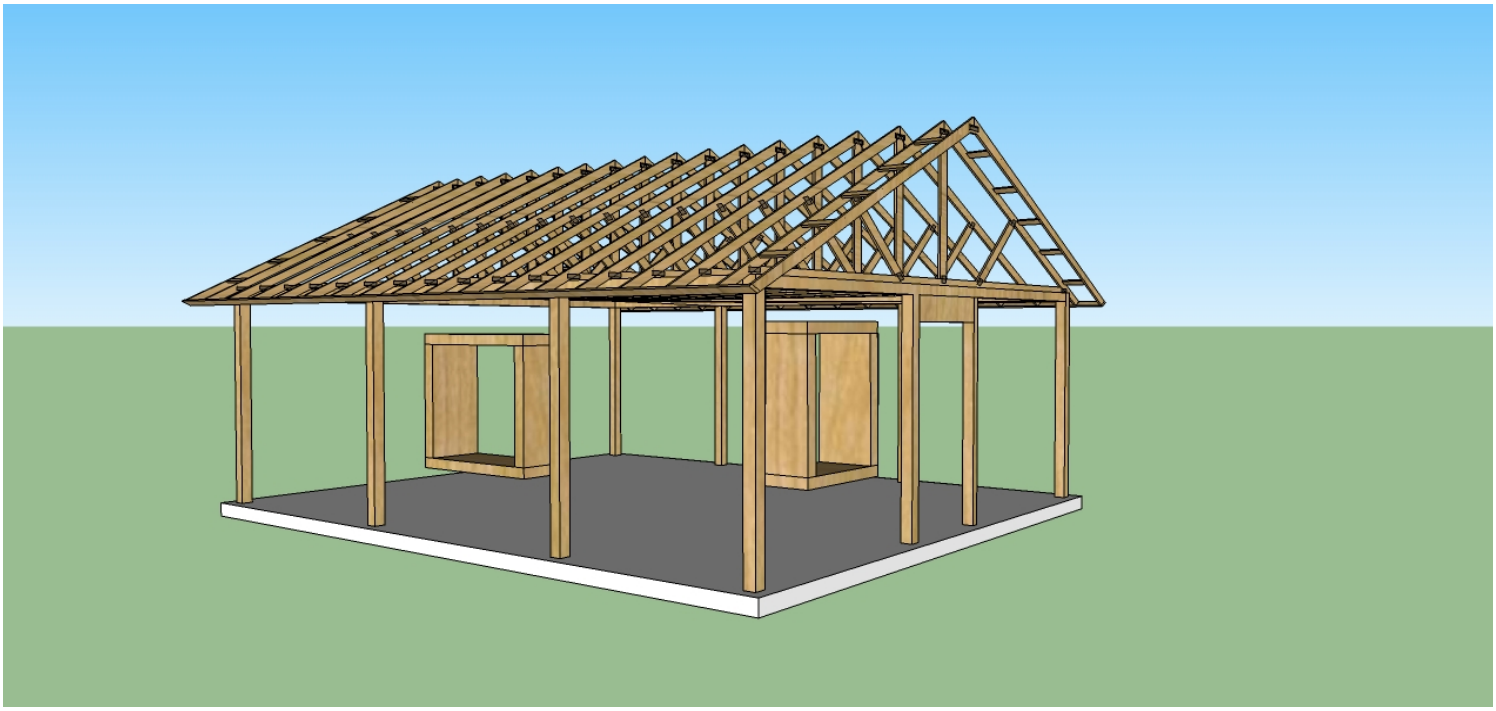
http://www.youtube.com/watch?v=NkgoC-RihCk

Books:





Pole, Timber Frame or Post and Beam Homes



In a conventional stick built home the floor and walls are tied together and the walls and roof floats on the floor. That can be a problem in areas prone to earthquakes, high winds or tornadoes. In a pole or post and beam home the weight of the roof is transferred directly through the pole or post uprights and the walls are non load bearing which gives superior strength.

A post and beam structure like the one pictured can be used with many different building styles including straw bale or adobe infill walls.

Pole barns use heavy duty treated poles usually placed in a cement footing below the frost line. The poles are placed at all corners and at all weight bearing points around the structure.

Here is a free PDF Instructions for building a pole barn: PDF How To Build a Pole Barn

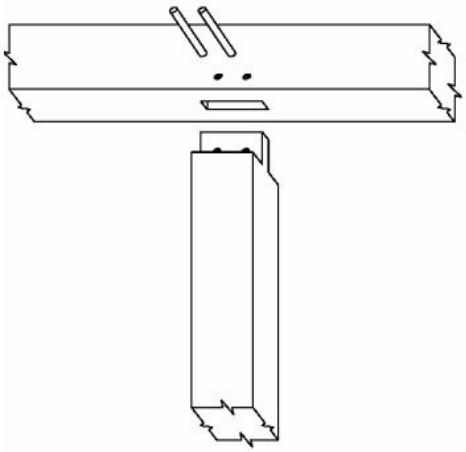
Open pole and post and beam structures can also be used to protect a shipping container home, RV or camper from heavy snow loads or used as a carport or enclosed to make a barn or home.

If you travel a lot and live in an RV a simple pole structure would be a good choice and if you ever want to settle down you could enclose the walls and convert it into a home.

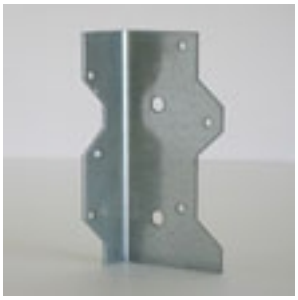
If you live near a lumber mill it is cheaper to buy poles and rough cut timbers for your pole barn so you can really save some money.

Post and beam construction is the same as pole barn construction only it uses conventional milled lumber that is available at any home supply store.

Some very well made homes use tenon and mortise joints for their post and beam which takes a lot of time and skill.



For those of us with less skill and time there are now many steel connectors that can be used for construction of post and beam and conventional home structures.



Corner Angle Brace

Joist Hangar

Rafter Tie Down

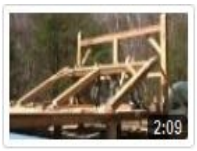
Post Base

http://www.framingconnectors.com/

Post and beam homes can be built any size and shape:

Videos:

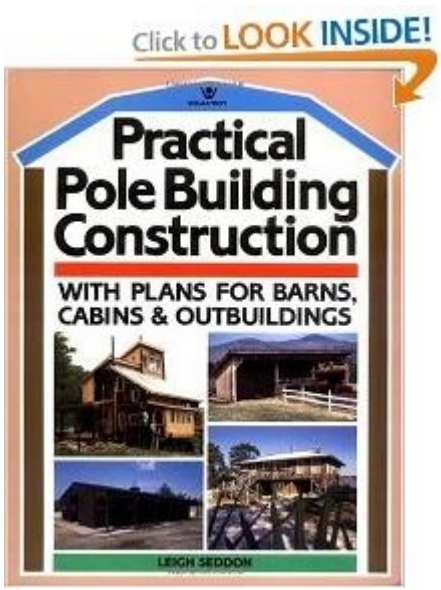
how to build a timberframe cabin
by randomredbanana13
14,468 views

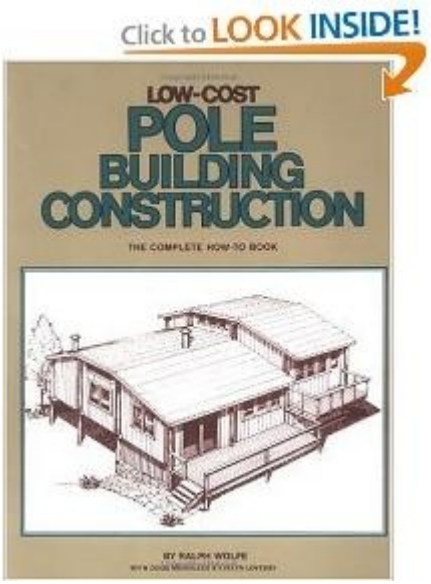


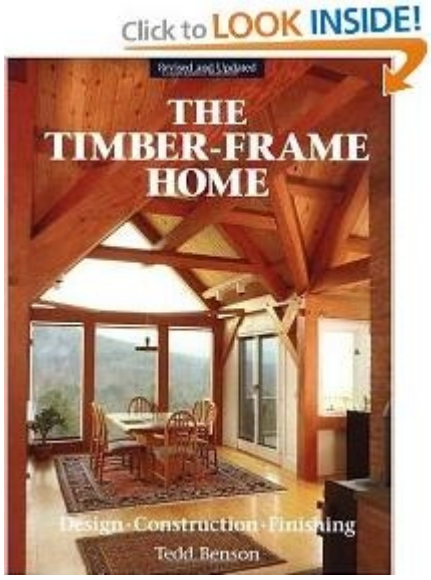
we built a **cabin**
A **timber frame** construction, in northwest connecticut by bring back barns
by BillLyon | 1 year ago | **4,914 views**
HD

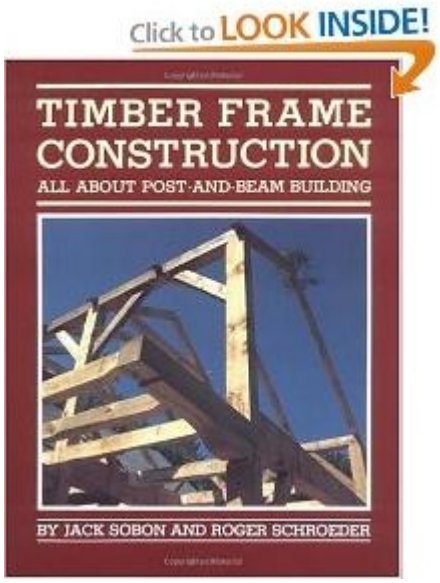
http://www.youtube.com/watch?v=eWOUIiELrNA http://www.youtube.com/watch?v=MRbi4jlIKkA

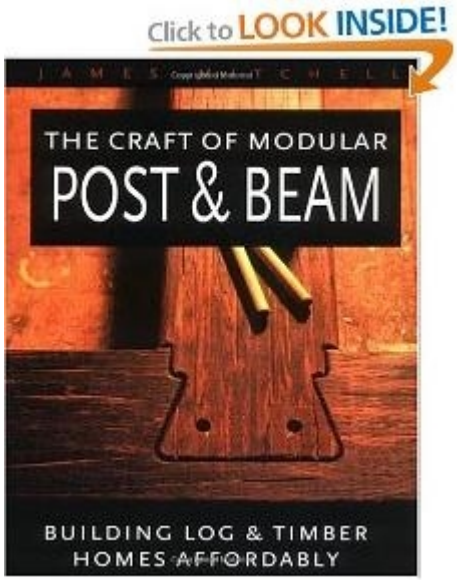
Books:

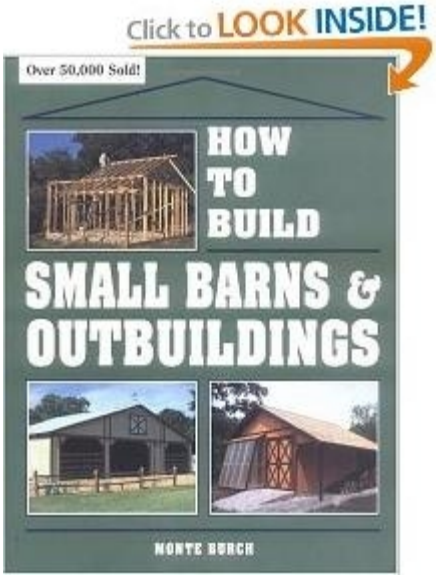












Living in a Camper, RV or Van

Many people have now given up their conventional homes and live full time in campers, Rv's or converted vans and this lifestyle is great for young people that are not ready to put down roots and older people that no longer want the expenses of house bound living.

If you don't mind living in a smaller space or do most of your living outdoors the small tow behind campers are a great choice. These can be self contained with their own water tank, shower, toilet etc. or just a bedroom on wheels.

Truck Bed Camper Self-Contained

Tow Behind Camper Self-Contained

Pop up Camper Not Self Contained

Tear Drop Camper Not Self-Contained

What kind of camper you need depends on whether you will be living in it full time and whether you will be living in areas where heating, cooling, and weather will be an issue. For year round living the fully self contained campers designed for that use would be your best choice.

Some things to consider when choosing a camper is the size and weight. Larger older campers will require a larger truck for towing which means more expense for gas. Smaller lightweight campers can be pulled with a small SUV, pickup and even a car.

People live year round in campers usually locating them at a friends house where they can plug in to utilities or in an RV campground where full service amenities are available.

There are literally thousands of RV campgrounds where you can rent a space and that usually includes your utilities and septic connection and many cost less than a few hundred a month. You can rent by the day, week or month and in off-season you can get some really great deals.

Or maybe you have purchased a piece of property for camping and will use that as your home base to park your camper.

I lived in a small older camp trailer for almost two years on my property while I was saving money and building my solar cabin. When the cabin was complete I scavenged all the appliances and fixtures from the camper for the cabin and used the camper shell for hauling stuff around my homestead.

Some things to know about camper living is most are not designed for winter living and lack winter insulation so if you will be living in a camper in winter you will need to take extra steps such as attaching a skirt to the bottom of the camper to keep out the cold drafts.

If you will be living for extended periods on your own land you may want to have a larger propane tank delivered to your property so you don't have to make so many trips in o town to get propane.

If you have a water well on your property you are in good shape otherwise you will need to haul in water or have it hauled in.

The only real drawback to camper living for some people is you will have to get by with less stuff!

Van Conversions

If you want to take it one step further many people use vans as their homes for camping or long term living and as long as you are not claustrophobic these can be very comfortable.

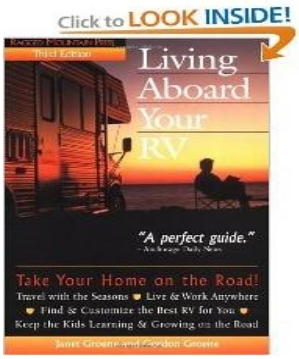
Fold down bed, sink, and stove in van

Tv, table, and fold down bed in van

If you can find a VW Bus- get it!

You can still find these camper vans around

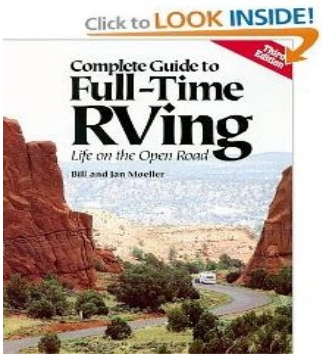
There are entire websites and groups dedicated to van living that will help you understand what is necessary to convert a van to a camper and how to make life in a van a pleasant experience.



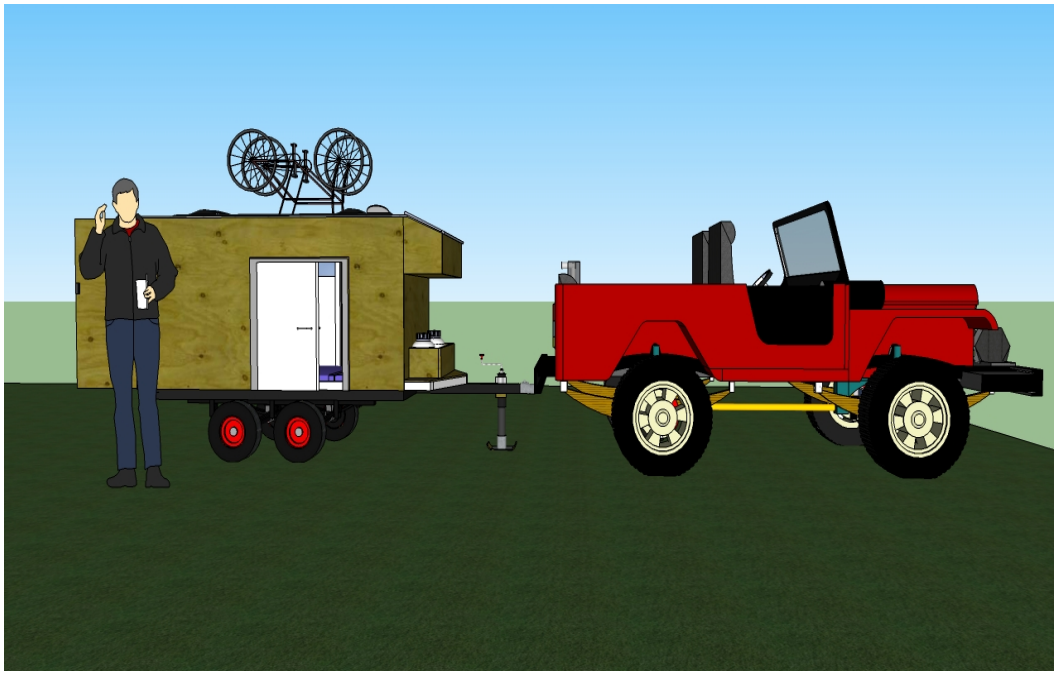
http://cheaprvliving.com/

http://vandwellers.org/

http://easyvanliving.com/

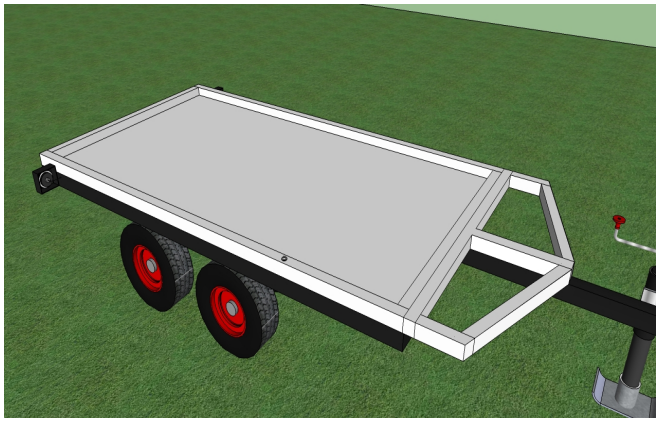


My $600 Solar Sport Trailer

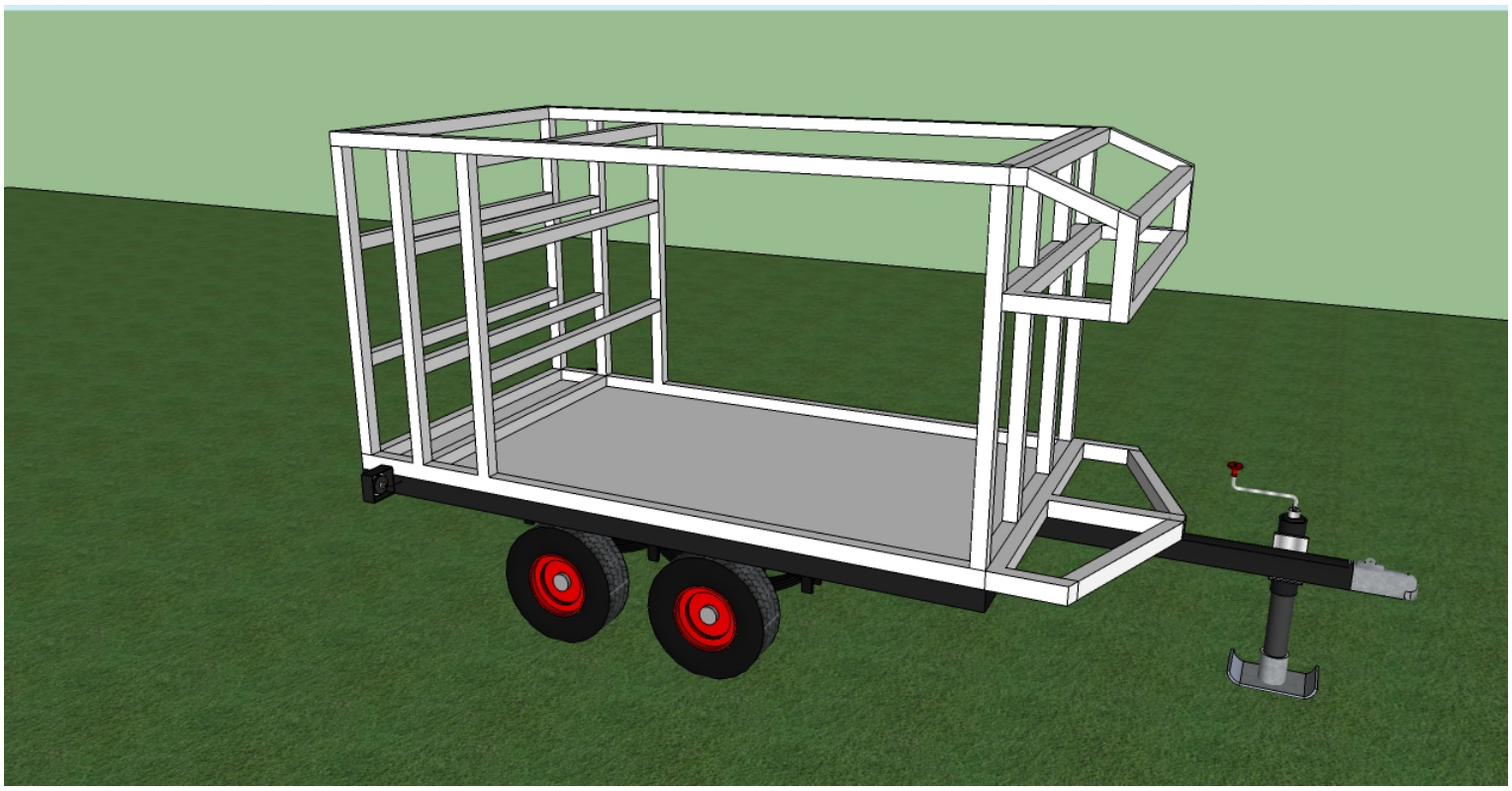


This is a 4x8 solar sport or bug out trailer built on a standard bare trailer frame. It is light weight so it can be towed by a small pickup, SUV, jeep or even a car and has bed space for two. The walls can be insulated for winter use. It is made from 5 sheets of ½ inch plywood, twenty 2x2x8. Two sheets 8 foot metal roofing and all joints are glued and screwed.

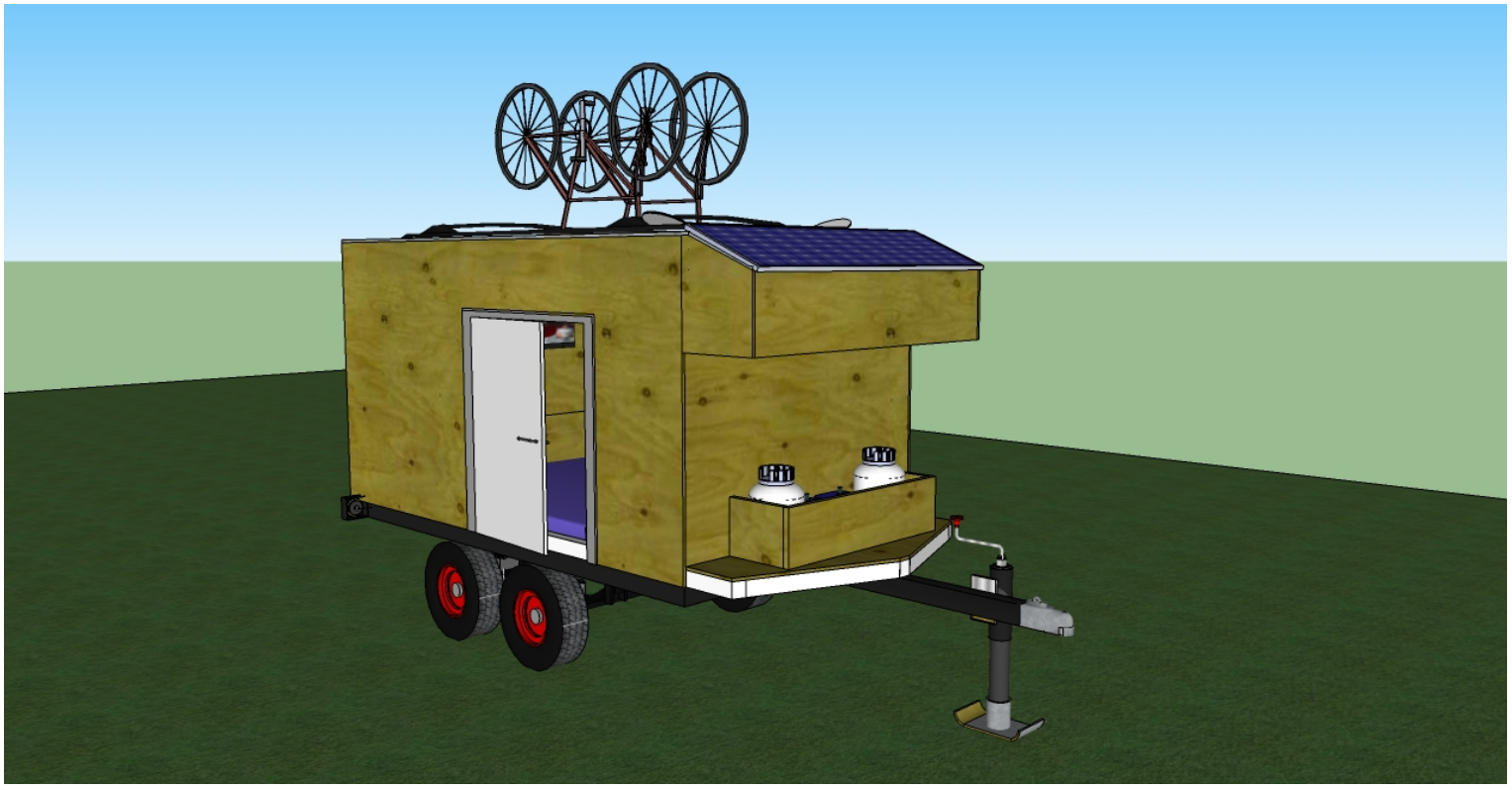
[Trailer from Harbor Freight]



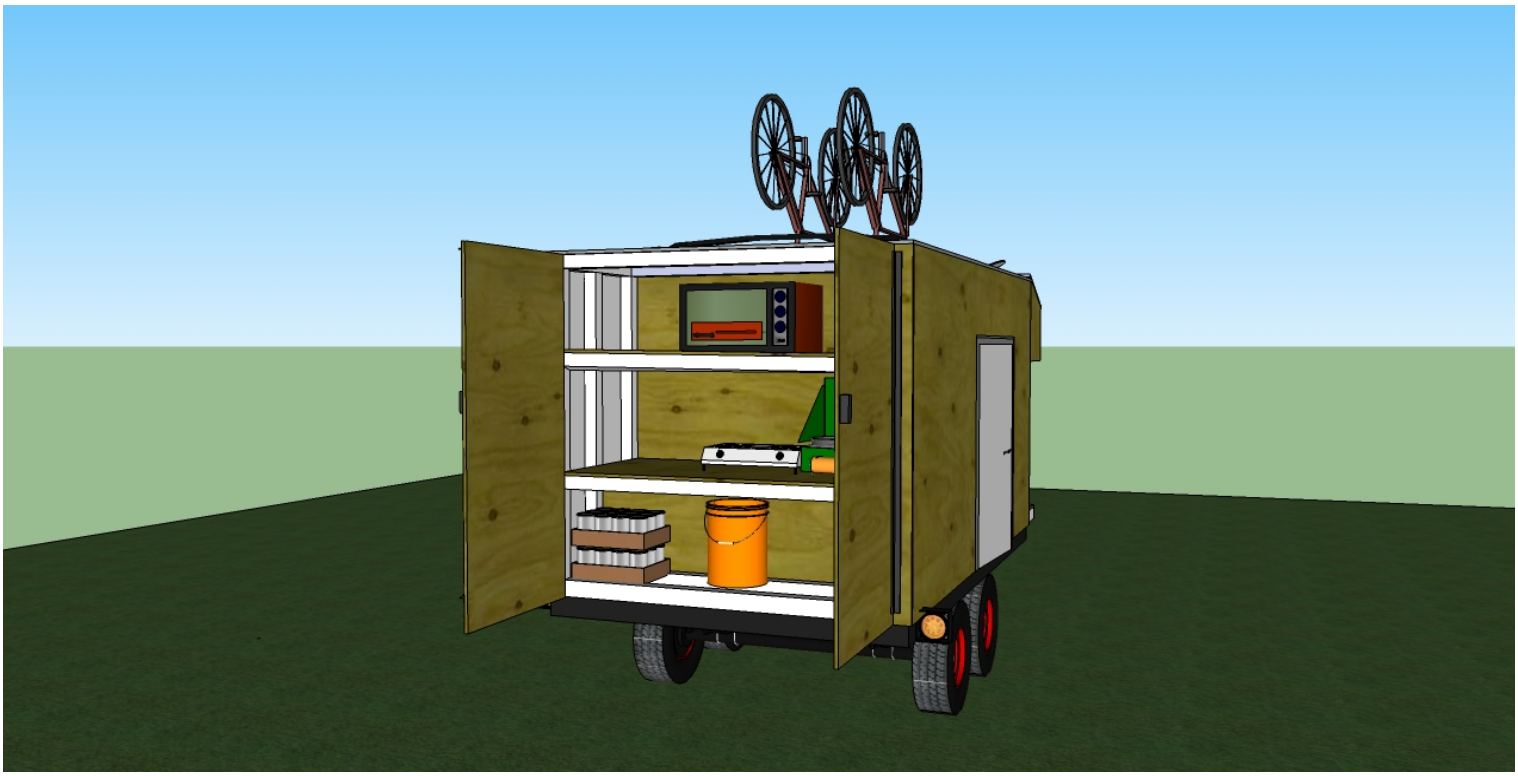
4x8 floor with nose deck



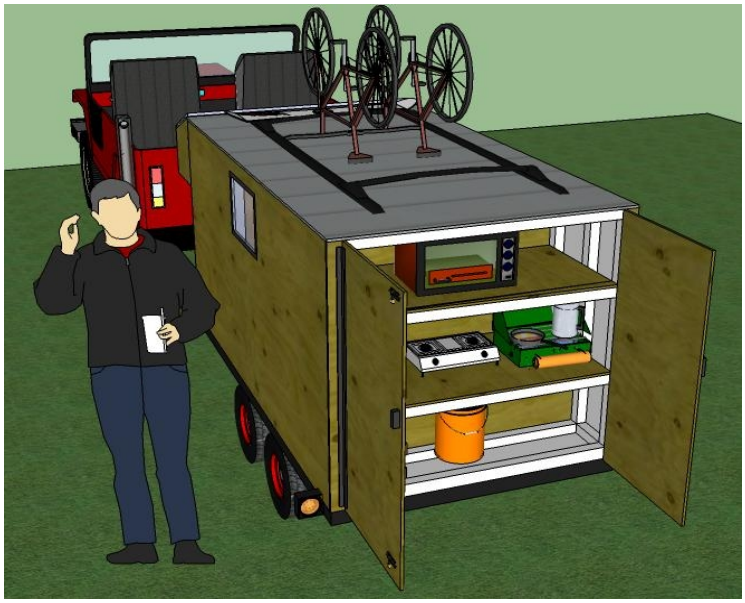
Frame is 4 feet tall and made from glued and braced 2x2 lumber



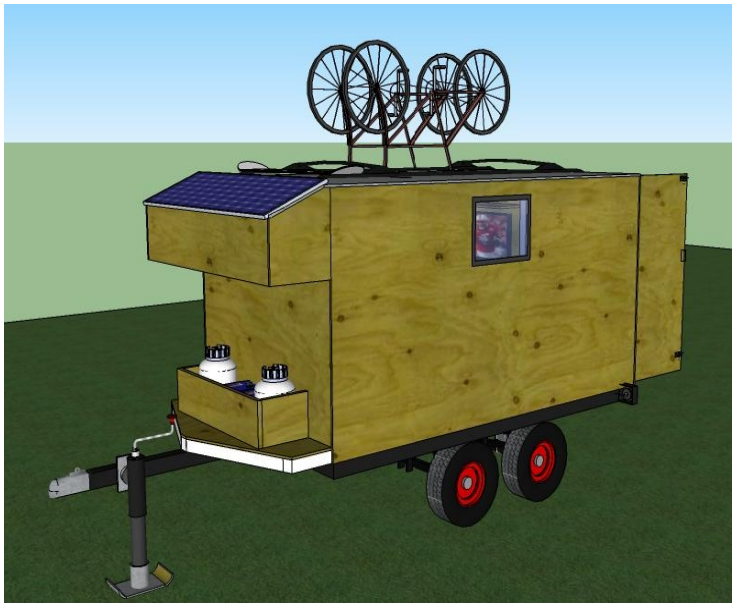
Exterior is ½ plywood painted or stained. Note solar panel and propane tanks. Door is 3'X3'



Doors on back open to reveal two shelves that will hold all your cooking gear and camping supplies



Roof is metal roofing with gasket screws



Window for Ventilation

The interior is large enough to hold a full size air or foam mattress. There are shelves for storage and space for a tv, radio, lights and gadgets. This is perfect for people that just need a space to sleep out of the weather and likes to cook outdoors. An 80 watt solar panel will keep your battery recharged and the propane tanks and battery all store on the nose deck.

Download the 3D Solar Sport Trailer File here: Download

How and where to buy cheap homestead property

A question I get asked frequently is “where can I find cheap property to homestead” ?

First we have to have a definition of homestead property so here is what I discovered.

Most homesteaders want a piece of property that:

- **has no or very lenient building codes or covenants**
- **allows animals**
- **has good soil and moderate temperature for gardening**
- **is rural but close enough to town for necessary shopping (1 hour drive)**
- **has adequate sunshine and/or wind to provide power**
- **has enough rainfall or groundwater to supply water needs**

<u>Why no building codes ?</u>

Building codes were originally designed to keep slum lords from building and housing people in unsafe apartments and hi-rise buildings and were only put in place for single family homes when states realized it was a good way to collect some money.

Construction contractors also like building codes because it keeps people from attempting to build there own homes and increases their demand.

The truth is most people can build there own homes with just basic skills and a little common sense. There are many local vocational schools that teach basic construction if you want training and many good do-it-yourself home construction manuals available.

I do recommend having an electrician help with wiring for a standard 110-220 volt system hooked to the grid but for an off-grid system like mine there is no reason you can’t do it all yourself.

There are still many rural areas in states that have no building codes or very lenient requirements. Some areas allow any kind of home but require an approved septic system. There are very few places that allow an outhouse but more counties are now allowing alternative septic systems like my solar composting toilet.

Many states are now encouraging rainwater harvesting and solar power as this reduces the demand on the states already overtaxed utilities. Many states even have rebates and incentives to purchase these systems so check with your state and county alternative energy departments.

If you build a homestead in a county with building codes you MUST follow codes or you may face fines and not be allowed to live in the home.

Where to find property

If you know the state and county you want to live in then start at the county offices and ask questions. I prefer to call and ask anonymous questions so as not to draw attention to my desire to build an off-grid homestead without building codes.

Many counties have internet websites and you may be able to download any building codes or restrictions right to your own computer.

Ask around- if you find a rural area you are interested in talk to the locals and especially anyone you think may be building an off-grid homestead and see if there are codes and how tightly they are enforced. It isn't unusual for a county to have codes but no building inspector or an inspector that is very lenient in their interpretation of the codes.

Generally speaking, most inspectors I have dealt with are not trying to keep people from building in rural areas so long as you are not creating an eyesore or obviously dangerous habitat. They are willing to work with you as long as you can demonstrate you have the knowledge to build the structure and have good plans to follow.

Nosy neighbors are your biggest enemy and you should avoid building near newer homes or in a housing development as these people will be concerned that your homestead will bring down the value of their homes. Find an area with few homes and one with homes and homesteads where your planned homestead will fit in.

One way building inspectors control how homes are built is through the permit application and control of utilities. If you try to build a house that doesn't meet code they won't approve or may have your utilities cut off. Now- if you build an off-grid homestead the inspector can not control your utilities and you take away their power!

How Much Land Do I need ?

This is a tough question to answer but I will give you my opinion. Most people think they need much more property than they do to homestead. My current homestead is just about an acre and is more than enough room for my cabin, a large garden, fruit trees, a solar greenhouse, chicken pens, rabbit hutches, and miscellaneous sheds.

If you want to raise more animals and have a little pasture then about 5 acres should be plenty. Many counties will only allow water wells on 5 acre lots or more so take that into consideration when buying your land. You also need enough room for a drain field if you are using a conventional septic system.

What Is Good Homesteading Land ?

Any land can be homesteaded and I even know people living on small islands, houseboats, rocky plateaus, and in the desert. It depends on what you want on your homestead and that's different for everyone. I would suggest you consider the following before purchasing any homestead land:

- **how big of a house or cabin do I REALY need**
- **where will I get and store water**
- **can I grow a garden and fruit trees if I want to**
- **will my neighbors be close or far away**
- **Is there good road access and guaranteed right-of-way**
- **can I keep animals if I want to**
- **how close is a town in an emergency**
- **can I get cell phone, radio, tv, and internet signals in the area**
- **Will I feel isolated and lonely or free to explore**

Grandfathered Homesteads

A grandfathered homestead is one that was built when a county had no or lenient codes and does not meet current building codes but is still habitable. You will find these older homesteads all over the country and these are a great choice to get a cheap homestead without the hassle of building codes.

The house doesn't even need to be in good shape as long as you can rebuild it safely and install safe wiring, water and septic system. Many old log homes and stick built homes have good bones and just need tlc and remodeling to make them livable. Really ugly little houses that have been unlived in for years are available cheap and with some work they become beautiful cottages and cabins for a homesteader.

If you find a grandfathered homestead don't rush to buy before checking the water quality, property lines, utility connections, heating, wiring, animal rights, and septic system, and right of way.

Tax lien properties

When property taxes are not paid for several years or property is abandoned then the county has the right to sell the property to cover the back taxes owed.

These tax sales usually occur once a year in most counties and there will usually be an announcement in the paper or contact the county treasurers office.

These sales are usually held by auction with the starting price set to cover the taxes. There may be complete homes for sale or just land which may be zoned residential, commercial, or agricultural. The county will provide a property description and I advise visiting the property to see if it fits your needs and why it is being sold.
Some properties become landlocked with no right of way or there may be a development planned or new dam or road construction planned that will take away your access so do your due diligence.

Be prepared with cash or cashiers check as most counties won't take personal checks or credit cards for tax lien sales.

Ebay or internet land auctions

I have purchased several homestead properties on Ebay and it is a good way to find cheap homestead land or foreclosed properties.

I recently purchased 5.3 acres near El Paso Texas with no building restrictions for only $700. It sits 20 minutes from El Paso so I can buy groceries and haul water and has lots of rain fall and sunshine for a cabin. I intend to build a second vacation cabin in a few years.

I also recently purchased 1.04 acres near Show Low and Snowflake Arizona for $510.
This property has lenient building codes and allows rv living. I intend to use this as vacation property because the area has lots of recreation including many lakes, bike trails, hiking, skiing, golf, and even a casino within an hour away. My property is remote with few neighbors and eventually I may retire to this homestead and build a larger cabin.

When buying through an internet auction always check the sellers feedback and I only buy from sellers with a lot of positive sales. If you pay by paypal or your credit card you have some protection in case the seller doesn't honor their end of the bargain.

Public lands

We are lucky in the U.S. to still have public state or government land that allows access. It is possible to legally use these public lands for temporary homesteading and more and more people are taking to the road in rv's and living on these lands free of charge.

It is also possible to establish a mining camp on public lands so long as you file the mining application and show that you are actively mining. The type of mining you do is up to you so panning for gold or using a metal detector is an acceptable form of mining. Check our state and local laws for information.

Camp sites on public land may or may not be free to use. Here in the Uintah mountains you can pay $5 a day to stay in a nice campground with water and septic dumping stations or you can find one of the many free spots that do not have any facilities.
If you have an rv or tent this kind of homesteading is very affordable and a great way to see new country as when you get bored just pack up and move to another campground.
Rv's can easily be solarized with panels and deep cycle batteries and a larger propane tank will take care of heating and cooking needs.

Homesitting or caretaking

Sometimes you can find an older homestead that the owner does not want to sell but would let you live there in exchange for taking care of the place. A little work each day caring for animals, fixing broken items, planting and caring for crops in exchange for a homestead might be a great deal and if you show you care about the place you just might get the owner to sell it to you down the road.

Senior citizens and disabled people often need a caretaker and may have a homestead with a second home or cabin on the property you can use in exchange for helping them.

Using the Internet to find cheap land:

Here are just a few websites that offer cheap land deals and also auctions land on Ebay:

American Land Company

http://www.americanlandco.net/

LandCentral

http://www.landcentral.com/

Classic Country Land

http://www.classiccountryland.com/

Your Own Acre

http://yourownacre.com/

Bargain Land Sales

http://bargainlandsales.com/

just type in the state you are interested in living in and the words CHEAP LAND and you will find many more real estate deals available. Many of these offer a low down payment and low monthly.

As always, do your due diligence and I highly recommend you visit the land and get a copy of the county building codes before buying instead of taking the sellers word for anything!

Buying land on Ebay

I have purchased two properties using Ebay and was pleased with both transactions. You will need to have an account with Ebay to purchase but that is quick and easy. If you have never purchased anything through Ebay you may have to contact the seller by Email to get approval to bid on any item that requires a purchase history.

Just click this link and see what land is available on Ebay today: land no reserve nr

When looking for land on Ebay type in NR for no reserve and you will see many good deals.

You can search by state and price and if you are looking for a place that has a cabin just type in LAND CABIN and see what comes up.

Ebay listings change everyday so wait for something you are really interested in. Remember it is an auction so if you find something don't be afraid to put in a ridiculously low bid and see what happens. I have seen 1 and 2 acre properties sold for under $200 on Ebay.

Most Ebay land deals will include a warranty deed fee and this will usually be around $200 and is added to the purchase price. Always get a WARRANTY DEED not a QUIT CLAIM deed for your land. Warranty Deeds have more protection in case the seller did not have the right to sell the land.

You will usually receive your Warranty Deed in about a month and most sellers include a plot plan with the geographic coordinates so you can pinpoint your land using Google Earth which shows you the actual terrain and location of the land.

I used Google Earth when I purchased my properties and using the coordinates they supplied I was able to zoom right in and see the land features, topography and nearby towns.

You can also use Google Earth to see any location: http://www.google.com/earth/index.html

Foreclosed Homes on Ebay

You might also want to look at foreclosed homes on Ebay to see what is available and it may be cheaper to buy a foreclosed home and fix it up than it would be to start with raw land and build.

Just click the link and see what is available on Ebay today: Foreclosures on Ebay

Many homes are foreclosed because the jobs dried up in that area but some are foreclosed because of crime and bad neighborhoods so do your due diligence and research the town and area.

Always make sure back taxes are current and paid up or you might get stuck paying someone's back taxes. You can contact the county office to confirm taxes are paid up.

These homes usually need TLC and remodeling and some could need major repairs so be prepared for that possibility. A general rule is if the foundation and roof is in good shape everything else can be fixed.

I have seen foreclosed homes go for less than $1000 on Ebay but you have to be prepared with the money upfront for most of these deals.

When buying a foreclosed home look at how much acreage is included. The house may not be worth saving but if it has a nice piece of land you may get a better land deal that way with all your utilities stubbed in. You can tear the old house down for materials to rebuild a new house.

If the property has utilities and land you have a head start on your homestead!

When you find some land

Once you have found some land you are interested in before you jump in and buy it I would highly recommend you do the following:

First visit the land and notice if it has right-of-way access available all year. If you have to maintain or build roads it can be very expensive.

Take a good look at the topography of the land. Does it have level land for building a house ? If not you can still build but it will take more work to level the land or build on a slope.

Notice the soil conditions. Is it rocky, sandy, or full of clay ? If so it may take more work to build if you will be excavating any earth for your home.

Notice the vegetation. Are there trees and other plants growing on the land ? If not it indicates poor rainfall or possibly contaminated soil. There should at least be weeds and sagebrush growing. If you want to grow a garden and trees you need good soil and if your land has poor soil you will need to fix it by adding humus and compost or have good soil trucked in.

Notice the climate. You should know that some areas near or in a desert will get extremely hot in the summer and other areas may get extremely cold in the winter. This will effect what type of house you want to build for comfort. You can use the internet to do a quick search of average temperatures and weather for any location and you will want to know average days of sun for your solar system, average days of wind for a wind system and average days of rain for a rain harvesting system.

Notice the utilities on the land. Does it come with a well ? Take a sample and have it tested by the health department. Look for power lines and phone lines that you may want to use. Test your cell phone for reception. Satellite will work almost anywhere. Is there a sewer connection available ? If not find out what the septic codes are and if you can use an alternative septic system. If there is an RV dump station nearby you can use that while you are building.

Visit the neighbors. Not everyone likes company but it does not hurt to stop and chat with your prospective neighbors to get a feel for the area. They may be able to tell you a lot about the area and if they are homesteaders they can give you some well needed advice for problems to avoid.

Visit the towns nearby. Find out what services will be available when you build. Is there a lumber and hardware store ? If not you will have to travel and truck in your materials. Is there a grocery store, hospital and pharmacy ? If you need regular medications or treatments you want them close.

Luckily, none of those things have to be a deal breaker because now-a-days we have the internet and can order stuff right to our door that may not be available locally but you should take the time to know what is available around your land before you jump in and move.

Now if you like the land I suggest you camp on the land or nearby to get a real feel for the area. Visit the places the locals hangout and enjoy the scenery and tourist attractions.

If you have done all that and still like the area and can live with any shortcomings it has then you are ready to buy and start your homestead!

How to make a living from your homestead

If you are serious about simplifying your life and getting rid of the house payment and utility bills and other monthly bills you will probably find that you do not need as much money and the money you have goes much farther.

This may empower you to do something besides a regular 9 to 5 rat race job and there are many opportunities for homesteaders to make a good living or side income from their homesteads.

I worked over 20 years as a teacher and retired with almost nothing in my bank account because of the large house payment, utility and other monthly bills I had living the "good life".

When I went off-grid I started with almost nothing but after starting a small one-man pest control business I found I had much more money in savings and I only work 3 to 5 hours a day and only 8 months out of the year. I have no house payment, no utility bills and my only monthly bill is for my cell phone/wifi internet connection.

I had so much free time on my hands especially in winter that I decided to start an internet business and that is how I got into writing books like this one and putting my education and skills to use.

Between these two businesses I have enough money to pay my few bills, afford health insurance, and put away for my retirement. I also now have the time to focus on making my homestead more self sufficient and time for my hobbies like fishing, camping and traveling.

If you want to save even more money your homestead can be used for raising animals and crops for food and you could even get into making your own clothes from homespun wool. However, raising animals is also an expense and time consuming so be sure that is what you want to do!

The best part of homesteading is the security you have. Knowing that you will not lose your home in another economic meltdown and you can survive and provide for yourself brings peace of mind. Our world is a chaotic place where wars, economic collapses, natural and man-made disasters are a common occurrence and being a homesteader makes those events a little less scary.

Many of you probably already have some skill or hobby that could easily translate into a homesteader business. Start with what you know how to do or learn how to do something totally new. There are many books, workshops and the internet to help you learn skills for a business.

The biggest hurdle that keeps people from starting a business is the fear of rejection or failure. Get over it! I have started several businesses in my lifetime and most failed usually because I was not prepared for the slow start up time it takes and I needed money right now.

Starting a business takes time, motivation, and dedication. If you have no pressing bills to worry about you have the time to start a business- the motivation and dedication is up to you. If one business idea fails just learn from it and move on to another idea.

So lets get started making money!

Businesses you can run from your Homestead

<u>Service Businesses</u>

A service business is when you provide some sort of service for your customers like yard work, landscaping, painting, pest control, handyman, window washing etc..

It can also include services like driving people to the airport, taking shut-ins home cooked meals, babysitting etc..

Service businesses are needed everywhere and homesteaders can make a good living providing a needed service in their community. Plus you get the wonderful satisfaction of helping people that is worth more than money!

My service business is pest control. I am certified, licensed and trained by the state of Utah to purchase and apply commercial grade pesticides to people houses to control insects and rodents.

Pest control pays very well and I get tremendous satisfaction when I remove dangerous and annoying insects and rodents and make a person's home safer. I can look at myself in the mirror and know I provide a needed service that helps people at a very reasonable price. That means a lot to me!

So how do you choose a service business?

First start with the skills you already posses:

If you have worked before you may have one or more of these skills-

House repair or construction
Painting or interior decorating
Landscaping or yard work
Gardening or animal raising
Mechanical repair or auto repair
Computer programming or website skills
Cooking or meal preparation
Baby sitting or elder care
Nursing or home health
Tax preparation or business development
Advertising or networking
Education or teaching
Photography or video production

This is just a short list of the most needed services and if you have a skill not on the list as long as it is needed by a lot of people it will work to start a service business.

Choose a skill that you have that people would pay for and answer these questions honestly:

Do I have a high enough level of skill that I can really help people?

Do I need to recertify or take classes to upgrade my skill?

Do I already have the tools needed or how much would they cost?

Is this a skill I enjoy doing or will I burn out quickly?

What would be the benefit of someone paying for my skill?

Is there a need in my area for that skill?

Once you have answered these questions you should know if you have a marketable service skill. I recommend you dig into your phone book and local ads to see if someone else is doing that service and how much they charge and what they do for that price.

Don't be discouraged just because someone else is already offering that service in your area!

When I started my pest control business there were already 3 pest control businesses here and people told me I would never make it work.

Today I am the only pest control company in my area and have over 2000 regular customers- and this is how I did it:

I called the other pest control companies anonymously and asked about their prices and service.

I figured out how much it cost me to do the same job and undercut their price by 30%

I also performed a higher grade of service and did more than what was expected for less money.

I used cheap advertising and word of mouth to keep my overhead costs very low.

I network and use referrals and coupons to get new customers.

I am honest, on time, guarantee my work and willing to do extra for the customer.

If you are willing to do those things then you will have no problem taking over the big share of business from your competitors.

Never talk bad about competitors but promote your service as being superior because of lower price, more service provided, guaranteed work, and honesty.

So you have a skill and you're ready to start a business?

Hold your horses- first call your competitors and see what they are offering people and make a list of what they offer and what more you can offer.

Find out the going rate for your service and figure out how much it will cost you to do the same job but charge less and offer more services.

If you need equipment find out how much it will cost to buy or see if you can borrow equipment from friends to get started.

If you need a certification or license get it first before starting the business.

If you need a business license then get the paperwork and get it done.

<u>Getting a business license</u>

Not all home businesses require a business license but most do especially if customers come to your home or you prepare food or offer any health related service. So get your license and don't start an illegal business that could land you in jail!

Your city or county will have the license forms and it may require an inspection of your property for some types of businesses.

License fees vary but usually less than $100 per year in most small towns and counties.

If your service is performed at the customer's home then getting a license involves a lot less red tape.

Just ask for the license application anonymously and don't discuss what type of business you want to start with the clerk. They don't have the decision power over licensing but they may not want you to compete with their friends or family businesses and accidentally lose your file or put in a bad recommendation. Nuff said…

When applying for a license I suggest leaving the service you will be offering as broad as possible. This allows you to add additional services under the same license without getting separate licenses.

For example call your service yard work instead of lawn mowing and this will let you include fence building, landscaping, pond digging, and general repair work under the same license.

So you have your license (if required)?

The wheels of government turn slow so allow 2 or 3 weeks for your license to be processed and don't nag the clerk or it might take longer.

Use this time to get your tools together and organized. Clean tools say a lot about a service person and rusty beat up tools do to. At least get the mud off!

Order some cheap magnetic signs for your vehicle: Vistaprint magnetic signs

Decide on your price and get some advertising flyers printed and ready to go. This will be your cheapest and most effective source of advertising.

If you have never dealt with customers face to face practice with someone on how you will talk to your customer on the phone and in person. DO NOT SKIP THIS STEP!

Getting customers is 50% price and service and 50% knowledge and communication skills.

You should be very knowledgeable in you skill and read every book and instruction manual you can find to increase your knowledge and use the vocabulary that goes with your skill.

You should be able to pinpoint exactly what the customer wants done and offer additional services that will make the service better and more valuable.

For example: I get customers that call wanting to get spiders out of their house. First I ask if they are seeing them inside or outside or both. Then I tell them what we do as a service.

"I treat the outside of the house, porch, deck patio, garage, woodpile shed and any place the bugs are breeding and feeding outside. On the inside I treat doorways and base boards and will spray into a crawl space and anyplace the insects are living"

Now my customer who just wanted their spiders gone knows that I do a complete service for insects in and around the home.

Next I tell them about safety "the products I use inside are designed specifically for hospitals, restaurants and homes. They are completely odorless and stainless and very safe for use around kids and pets".

Now my customer knows I take safety seriously and will keep their family safe.

Next I tell them my guarantee "I guarantee my service for 30 days and we come back and spot treat if it is ever needed."

Now my customer is assured I will do the work and guarantee it or do it again.

Finally and last I tell them the cost "I charge $49 that is for both inside and outside the house".

By the time I get to the price the customer is already impressed by the service and when I mention how low the price is they jump to get an appointment.

NEVER-NEVER-NEVER start a conversation with a customer by discussing the price!

Even if they ask "how much do you charge for this service ?" first ask them what it is they need and tell them what all you will do for them- then hit them with your low price which is 30% less than competitors and a better service.

THIS WILL GET YOU CUSTOMERS GUARANTEED!

Customers are savvy and most have checked around and know your competitors service and charges so if you give them just a low price they may think you are offering bad or less services or maybe it's a scam. Tell them what you will do and your guarantee and then give them the price and they will be much more receptive.

So sit down and write out a short speech that you can memorize to use whenever talking to customers on the phone or in person. Keep this speech in your hand when talking on the phone for a reminder but memorize it for face to face conversations.

Include:

- **Services you always offer to every customer**
- **Safety and guarantee**
- **Price for the service**

Your customer may want to negotiate the price or ask for special services and I stick to my low price but will throw in an extra service if it adds little to my time to do the job.

If a lot of customers are asking for this service you should add it to your list of regular services.

If a customer wants more than my average service then I set a reasonable extra charge for that service and most customers are very willing to pay a little extra and most offer to pay extra without being asked because I already provide so much in my service.

IF you will memorize a sales pitch and can repeat it without getting flustered in front of people you will appear very confident, professional and knowledgeable to your customers and that is what gets customers and repeat business.

<u>Advertising your business</u>

There are many different ways to advertise your business but here are the most effective and least expensive that I have used and will work.

Word of mouth

Your best free source of advertising is word of mouth so use it. Tell people about your business and especially friends, family and neighbors.

If these people will help you out by referring customers give them a break on their cost and it will be paid back ten fold.

Give these people your business cards or flyers and tell them if they like your service please let their friends and family know.

In my small town everyone is friends or family of someone and these ties will not only get you one customer but every cousin, aunt, and uncle's business as well!

Remember that bad service is also spread by word of mouth so treat your customer's right and they will take care of you for years to come.

Flyers

You have all seen them stuck on people's windshields at every store in town. They may seem annoying and can be if over done but a well designed flyer can really get you customers because it gets in their hand and will be read.

I use small black and white quarter page flyers. I print four flyers on each page and cut the flyers out. This costs me less than a penny apiece for a flyer.

Each flyer has a small picture of a spider and an attention getter like "Got bugs ?" or "Did you know ?" or "$5.00 off coupon!"

Under that is the description of my business services, guarantee, price and contact information.

I put these small flyers on the driver's side windshield under the wiper so it doesn't blow away and the customer has to get it in his hand to remove it and hopefully read it.

I can put out 1000 of these in less than an hour just walking around any large store parking lot during peak business hours.

Do not be surprised if people chase you across the parking lot and want to set up appointments immediately and be prepared with an appointment book and pen!

Newspaper ads

Newspaper ads are generally expensive and not worth my time but if you have a local paper or ad paper it would be a good idea to list your business in their at least until you get rolling and then just every few months after that.

Online community newspapers are also good and if your community doesn't have one why not start one and give free ads to readers and charge businesses for commercial ads- that's called an online business and you can run one!

Always include your services, guarantee, and basic price in an ad or you will get very few calls. People want to know what they get for their money.

Phone book ads

Generally expensive but if you are competing with other businesses that are in the phone book then you should be in there as well.

I traded pest control with the phone book company owner for free ads for 3 years and you may be able to reduce costs that way.

A big picture ad is not necessary and just the business name and phone number will cost less and is usually enough once people know you are in business.

Signs, banners, and billboards

Definitely put signs on your vehicle with business name and phone number, and some services you provide. If you go to houses people will see you working and note your number or see you every time you park some place or stop at a light.

I use cheap magnetic signs I can remove when not doing business and these are available in the resource chapter.

If you live in an area with lots of traffic house signs, yard signs, and banners can attract a lot of attention. Check with local ordinances before doing this.

If you think your company is big enough news rent a billboard or side of a building or truck trailer and put up a billboard. These should look professional !

Use public gatherings

Anytime a crowd is gathered is an opportunity to advertise. Put a float in the local parade, hand out flyers, give away coupons, fly a small hot air balloon, and wear your company shirt with advertising to all events you attend.

Radio and TV

Generally way too expensive for a small home based business but if you have a small local radio station or high school or college radio station these are less expensive.
I traded pest control at the local radio station for a months worth of radio ads.

Business cards and clothing

I dislike business cards but I use my flyers as my business card and give these to all potential and active customers. I hand my customers 3 flyers at the end of my service and ask them if they know of anyone else that might be interested in a service please give them the flyers.

The flyer business cards are great to stick on a fridge and I put a "next service reminder" at the bottom so people know when to call me back.

Get some t-shirts or work clothing printed with your business name and contact information (sources in resource chapter).

The clothing makes you look more professional and you will be surprised ho many people read shirts for advertising!

Coupons and give aways!

I do at least one coupon every year and it has always landed me a lot of new customers and made me very popular with my old customers. I usually do a $5 off referral coupon I give to my existing customers. If they refer one other new person that takes a service they get $5 off their service. I give the new customer one as well and anyone they refer as well and pretty soon I have many new customers- it always works!

Do not overuse the coupons and I reserve them for good customers with lots of family and connections. You will make a little less money per service but gain 3 times as many new customers so it is worth it. Once your customer base is established you will not need to use coupons very often as your customers will know your value.

Internet web pages

Everyone is online these days and many people use the net for searching for local or unique businesses. Set up a simple web page with you services and contact info and put the link on your flyers and in other advertising you do. Set up a facebook acount and use it to advertise and network. Yahoo offers free forum groups as does google.

You can get a nice free website like the one I use here: www.webs.com

Service businesses

Pest Control

Truck with magnetic signs

4 gallon backpack sprayer

One gallon pump sprayer

I started doing pest control after my cousin started a business doing it and asked me to help out. When I seen how easy it was and how much money could be made while helping people I started my own business in a different town.

Most states require a pesticide applicator to be licensed and the licensing depends on the state but most require at least a test and some on the job training or classes.

You will also need a business license and liability insurance may be required in some states.

My business day consists of answering voice mail from customers and setting appointments for the week. I am flexible and will work around the home owners schedule to get it done.

Then it is out the door to the first job. I always arrive on time or even a few minutes early. I talk with the customer about their specific bug problems and have them show me trouble spots if necessary.

Then I get busy- the outside of the house, garage, sheds, woodpile, deck, porch and trouble spots are sprayed with the 4 gallon backpack sprayer (above) and this can be done in 20-30 minutes for even a large home.

The inside is done next and depending on what the customer wants I do all baseboards, basement, in to the crawl space, around doors, and under sinks.

I usually strike up a conversation with the owner while working and it may be about pest control or just the weather or family issues since I know most of my regular customers very well.

It takes about 10 minutes to do the inside and when I am done I tell the customer when their next appointment should be, give them 3 flyers to give to friends and family, and take their check or cash.

The whole job takes 30 minutes and maybe 10-15 minutes drive time and I charge $49 per job for an average home.

I can usually do two jobs in an hour so gross profit is about $100 per hour and sometimes more. I average 5-6 jobs a day and in peak season I do 8-10 jobs. Termite treatments require special services and I charge $300 or more.

Because I can buy industrial grade pesticides in bulk my cost for the pesticides is low and the customer gets a better treatment than using over the counter sprays which are 10 times weaker and usually more dangerous.

Some signs for your vehicle, a backpack sprayer ($100), a pump sprayer ($40), some pesticide resistant gloves and masks are all that is really needed to start this business plus whatever advertising you do. You must get licensed and certified for any pest control business!

I really enjoy my work as I am outside at different places everyday and I am helping people have safer healthier homes and doing it at a very fair price. I work from March to December and have winters off and can schedule a vacation whenever I want one- how many jobs let you do that !

<u>Yard Work</u>

Trailer with yard and landscaping tools

People are doing more of their own yard work these days but there is still a huge demand for experienced people to mow lawns, trim trees, plant landscapes, clean gutters and do general yard maintenance and repair work.

All you need to get started is some basic tools like shovels, rakes, pruners, brooms, a ladder and maybe a good lawn mower (or use the customers).

You can use a truck or trailer as shown in the example above and keep your tools organized in some sort of caddy.

You can add equipment like power washers and roto-tillers as your business expands and these services can be add-ons or separate services you offer customers.

Always remove any debris you create and leave customers yards clean and neat.

A friend of mine owns a small yard care business and charges $50 per home for basic care like mowing, pruning trees, cleaning flower beds, and edging. He adds to the price for specialty services like tilling, cleaning gutters, and power washing decks, houses and sidewalks. An average job takes him 1-2 hours.

He does several homes a week and has regular customers set up on a schedule for work and he is never hurting for new customers. He refers them to me for pest control and I refer customers to him for yard work- gotta help a fellow homesteader!

As long as you are careful and conscious of what you are doing and don't break things or dig up power lines (call blue stake before digging) your customers will be happy.

There are lots of additional services you can offer your customers like garden tilling, mulching, weed removal, leaf removal, fertilizing, fence building, and installing sprinklers if you have the skills and tools.

<u>House painting and handy man repairs</u>

Always a lot of demand for this type of work and if you have house painting skills or home repair skills you will get customers!

Older homes may need a lot of scraping and paint removal so the work can be long and hard but the pay is good at an average of $20 per hour.

You will need professional paint equipment and an assortment of brushes, rollers, extension handles scrapers, ladders, scaffolding and probably a truck to haul it in.

You will also need miscellaneous repair tools, tarps, buckets, a drill and paint stirrer, gloves and mask tape.

You will need to bid your jobs based on hours to complete and paint required. You can purchase the paint or have the homeowner buy it and you just supply the labor.

Home repair is usually fixing broken things or building and replacing stuff that gets broke around houses. Lots of people need this help!

Wood fences need repair and painting or staining. Sheds need doors fixed and so do garages. Play houses and jungle gyms sets need repair or building.

There is a big demand for yard sheds and I have built several for neighbors in the past. A basic 8x8 shed costs under $400 to build from good materials and sells for $1000.

Gambrel yard shed: http://www.mybackyardplans.com/storage_shed_material_list.php

Inside the home there is painting needed, baseboards installed, cabinets replaced, additions built, closet organizers designed, and drywall to replace or repair.

Only do the jobs you have the skills for and stay away from plumbing and electrical work unless you are licensed to do that work.

Bid your jobs based on time and always allow yourself extra time to do it right!

Gardening

Many people want to garden these days and have fresh food for their tables but a lot of them need a guiding hand from an experienced Gardner and are willing to pay for it!

Services include designing garden and building garden beds, improving the soil, planting seeds and starts, harvesting gardens, mulching, and fall cleanup.

Most customers want you to teach them as you do these things so they will be able to do it themselves so you become their instructor and hands on guide.

You could offer this as a class and have several customers go to one customer's house for lessons. Charge each customer a reasonable fee of $20 and you make a $100 an hour for each lesson. Have a spring planting lesson, summer growing lesson, and fall harvesting and clean up lesson.

If you also have a booklet describing what you do and pictures of vegetables and how to grow them best this can be an add on and charge them a reasonable price for the book. People always like guide books and will want one for themselves and friends.

You can also do gardening for people that can't do it for themselves or would rather pay someone to do the work. Elderly people and disabled people would love to garden but need help. You would be providing a great service to these wonderful people.

Your service could be preparing the garden beds and spring planting, fertilizing and watering, harvesting and fall clean up.

You could include a book on recognizing the vegetables and fruits and how to cook them or preserve them and types of canning methods you use.

There is a Master Gardener certification available but if you grow a great garden and have admirers you will have no problem getting customers for your business.

This is a great business service to add to a yard work business as well!

<u>Chimney cleaning and wood hauling</u>

Chimney sweeping is a great business that provides a needed service to wood burning customers. Those same customers are also potential customers for wood hauling.

Chimney sweep equipment consists of round and square brushes designed for metal and mortar chimneys. Also needed are fireplace cleanout shovel, ash removal bucket, tarps, ropes and a canister vacuum with a long hose and an extension ladder.

My brother did chimney sweeping for many years and made a nice income while helping people keep their homes safer. Creosote builds up in chimneys and if not removed it can cause chimney and house fires. People need this service!

There are many books and websites dedicated to chimney sweeping but it takes hands on experience to do it right. Practice on your own and friends and family members chimneys before taking on paying customers homes.

The charge for this service varies by home and time needed but my brother charged $100 on average and $200 for anything complicated.

This is a year round business but more customers need it in the fall right before burning season so get your flyers out and and hit up any home that has a wood chimney for customers. If you are fast and clean up after yourself people will spread the word.

Wood hauling can be a single service business or works well with a chimney sweep business as your customers are the same and need both.

If you have a truck, a good chainsaw, saw horse and wood buck, and a strong back this is a great business to get into. Experience choosing trees and cutting wood is a must!

If you have acres of trees on your land you may use that as your supply but if not you will need permission from land owners or a permit to cut on private land, Contact your county AG department for help with permits.

Wood can be sold by the cord, by the ton, or by the truck load and as winter draws near people will buy out as much as you can provide so you will stock up in spring and summer to sell for winter.

You can unload and stack the wood for customers and this will get you more customers or do a general drop off and leave that to the customer.

Many people are using pellet stoves now and if you can buy pellets in bulk and offer to deliver them to customers at a better price than they can get in town you can add that to your services.

Want to make more money- install woodstoves and stove pipe and repair rusted and old looking stoves!

<u>Mechanical repair or Auto repair</u>

If you can repair mechanical things then you are a wanted person! Wanted by everyone including me when an expensive piece of machinery breaks down.

Repair shops charge too much and have a backlog a mile long and we need it now so if you have the skills and tools to repair equipment starting this business is easy.

Customers will bring their broke stuff to you or go to their place to work on larger equipment. Tools vary with the trade but standard mechanical tools and electronic testing equipment is usually required if you don't already have it.

If you specialize in just small motor repair or farm equipment repair you will know what tools you need and can rent or buy specialty tools as you go along.

Lots of repairs are simple like changing a spark plug or replacing a clogged fuel filter but some can be very complicated so pick your jobs carefully and if it is beyond your abilities or tools then give it back quickly so the customer can get it fixed or buy a new one. Don't hold on to people's equipment for long periods or risk a bad reputation.

Your garage can be turned into a shop for working inside and protecting equipment from theft. Always return equipment cleaner than you got it.

Basic auto repair can be done at the customers home or as a road side service or at your home shop. Charge by the honest hour and extra for parts.

Repairs can be minor like changing a flat, replacing a battery, doing a tune up, or exhaust and brake work. Or more skilled like engine overhauls, body work, and custom car building.

Having a jump start service in winter is a good side line and getting locked cars open is also a valuable service. If you have a truck that can be equipped to tow a car you can offer this service and always have a full gas can for stranded motorists!

<u>Animal raising and selling</u>

If you have animals on your homestead and most of us do then there is no reason you can't start a business selling animal offspring or the products they produce.

A few does and a buck rabbit will produce a multitude of baby bunnies and these can be sold as pets, food, fur and rabbit droppings can be bagged and sold as fertilizer.

Miniature cows are very popular because they produce ¾ the meat of large cows for half the food. They can be raised on small 1 acre homesteads so people like them.

Milk goats and specialty breed goats are usually in demand and they produce milk that is more digestible for people with milk allergies and wonderful cheese!

Chickens are a huge money maker for fresh eggs and can be processed easily for meat, feathers and aged chicken manure can be bagged and sold as fertilizer.

Animals can be sold through auctions or by advertising in the paper or with flyers. Be willing to let people visit the animals and give them good info on how to raise them. A simple booklet with basic raising instructions will save you and them a heartbreak!

Raising pedigree dog breeds and cat breeds can also produce income but puppy mills with poor living conditions are making headlines so don't go down that road.

Stick with just a few animals and always have animals vet shots and neutered or spayed if possible. Specialty breeds go in and out of fad quickly so don't get stuck that way.

Prices vary greatly for animals and pedigree, health, and living conditions will make a difference in price. Only sell healthy animals period.

I raise chickens and rabbits for my own food supply and sell off excess offspring and eggs. I advertise at the feed stores when these are ready and give a small booklet to people new to animal raising that explains care and housing- the animals sell fast!

<u>Worm farming and fish farming</u>

Red wiggler worms

DIY worm farm

fish farm in a pool

Worms are fish food and worms also produce excellent fertilizer called castings as they eat tons of waste turning it into raised for fishing bait and sold in almost every country grocery store around and valuable compost. They are a win-win business!

Getting started is easy and there are many worm farm designs that can be built from scraps at home. Starter worms can be ordered online and some worms are better than others so do your research. Sources for worms are in the resource section.

You can sell fishing worms from your home or set up businesses with a small fridge and a supply of worms in bait boxes. Add meal worms (a type of grub) and scented worms and you are a fisherman's best friend. Scent products are available online see resources.

The byproduct of worm raising is a rich black compost called worm gold and sold as a specialty fertilizer to flower and garden shops or to customers that know it's worth.
Worms eat, breed and produce worm gold continually so this is a year round business that takes very little time or money to operate. Anyone can raise worms !

Package small 1 and 2 pound bags of worm gold in recycled paper bags lined with a recycle plastic bag and stamp a fancy label with details on worm gold properties like amount of nitrogen etc. and sell it for $5 or more a bag. People will buy it and love it!

Fish farming called aquaponics is making a huge surge as a business. Fish are sold as food and the byproduct is a rich liquid fertilizer that will grow your garden to tremendous size.

Tilapia are the fish of choice but catfish can also be raised at home in small above ground pools. You will need to research pool size and fish raising before jumping in and there are many websites dedicated to this farming method.

These fish breed like crazy and produce a very tasty and easily digested meat. Pound for pound they are the cheapest source of meat you can raise in a small area.

You will need to find outlet stores for your product and meet their standard so do that firsts but fish can be cleaned and frozen and sold to customers directly. After excess water is removed the fish waste is bottled and sold to flower and garden stores as fertilizer at high prices. Dead fish can be ground into fertilizer and sold!

<u>Bee keeping</u>

Bee hive and colony

Bee with pollen sacks

Making sweet honey

Bee raising can be a great way to make money and you will be helping our ecosystem!
Bees carry pollen to and from flowers and other plants which greatly aids in pollination and is necessary for most plants survival. They also feed the pollen to the bee colony and create honey in a hive or comb.

Bee raising can produce multiple streams of income:

Honey is valuable by itself and as an ingredient in other foods and natural honey products or pure honey can be sold directly to customers or through store outlets.
Bee wax which is removed in processing the honey is used for candle making and an ingredient in makeup.

Farmers, gardeners, and fruit tree growers absolutely need bees for their pollination. Bee hives are transported all over the country to these farms and farmers pay big bucks for the service.
Bee keeping can be learned online or through an AG extension program. Startup costs are minimal for a few hives and you would need a bee suit, smoker, hives, honey extractor, product containers and of course – bees.

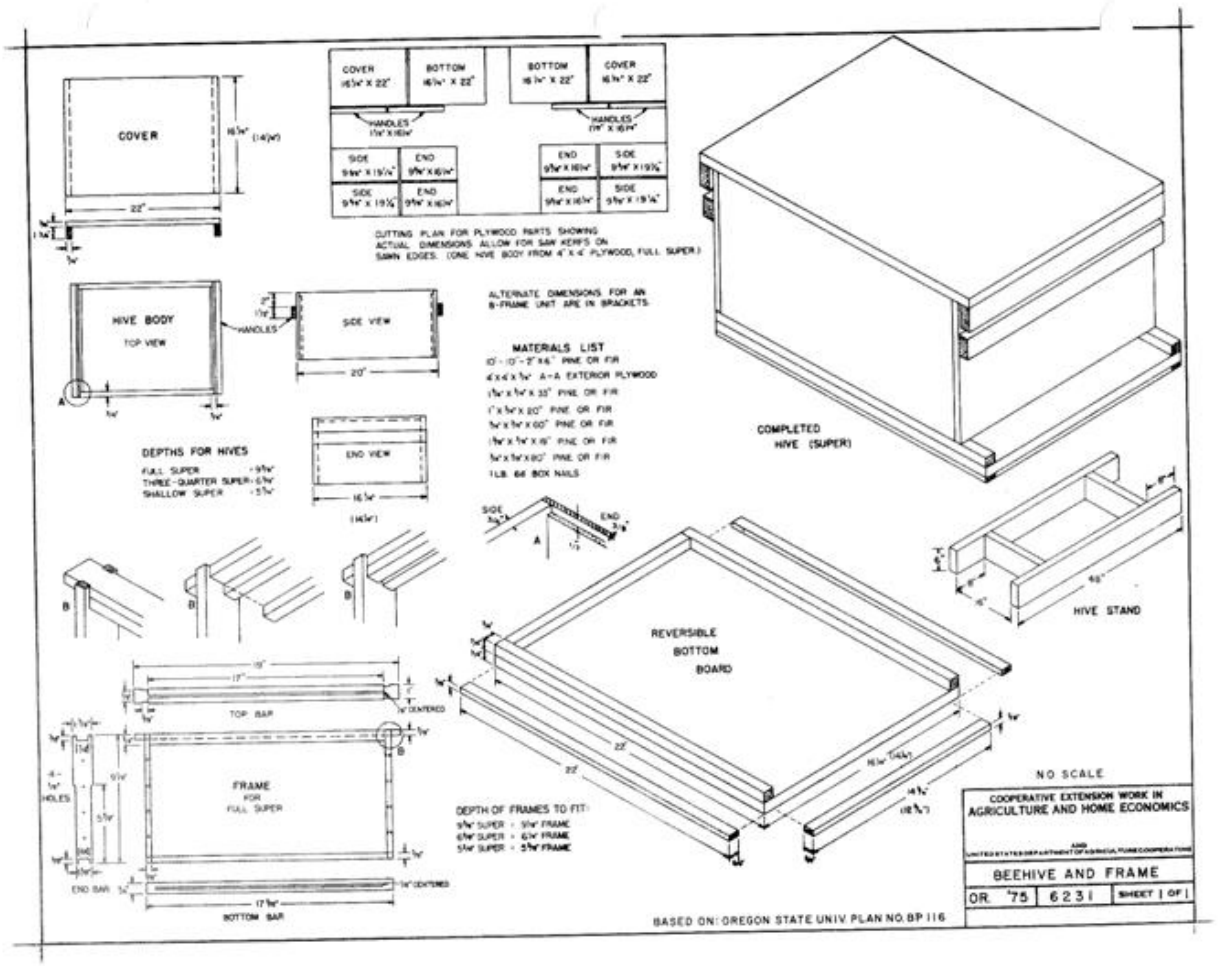
Before starting this business contact local farmers, gardeners and fruit growers and ask if they need a bee pollination service. My guess is you will get a very positive response!
Check stores for handling honey and this would be a great online business for selling bee wax candles or candle supplies.

Without bees we would have very few vegetables, flowers, fruit, trees and the human population would suffer greatly. This is a business that not only makes you money but will to strengthen our fragile ecosystem.

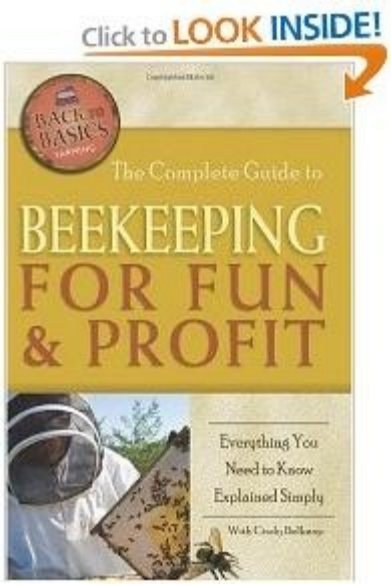
Your own garden and farm will also benefit from having more bees for pollination. More bees mean more plants and the better the crop. If you grow food to resale bee keeping would go very nicely with that business!

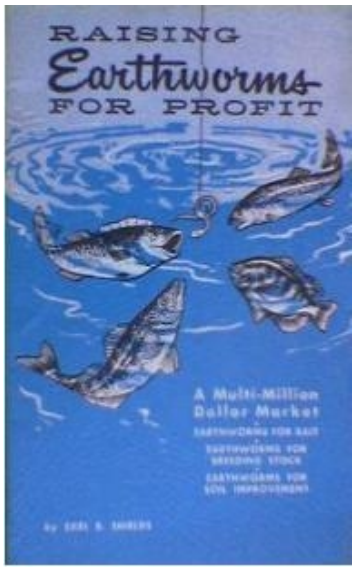
Public domain image of basic beehive construction courtesy North Dakota State University

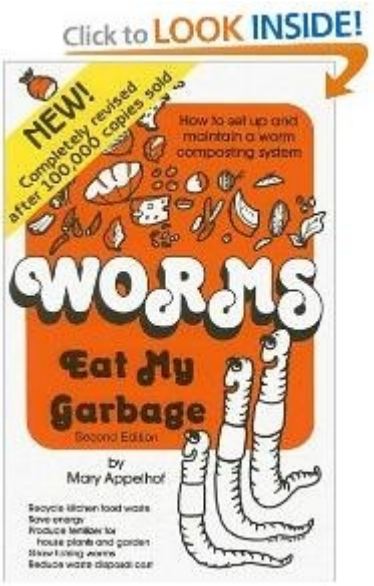
http://www.ag.ndsu.nodak.edu/abeng/plans/6231.pdf

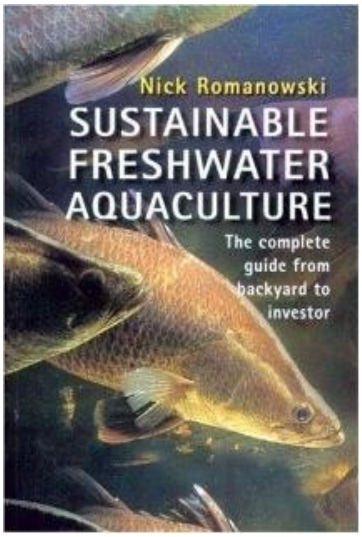

COVER
BOTTOM
HANDLES
SIDE
END
CUTTING PLAN FOR PLYWOOD PARTS SHOWING ACTUAL DIMENSIONS ALLOW FOR SAW KERFS ON SAWN EDGES. (ONE HIVE BODY FROM 4' x 4' PLYWOOD, FULL SUPER)
ALTERNATE DIMENSIONS FOR AN 8-FRAME UNIT ARE IN BRACKETS
HIVE BODY
TOP VIEW
SIDE VIEW
END VIEW
MATERIALS LIST
1 LB. 6d BOX NAILS
DEPTHS FOR HIVES
FULL SUPER - 9⅝"
THREE-QUARTER SUPER - 6⅞"
SHALLOW SUPER - 5¾"
COMPLETED HIVE (SUPER)
HIVE STAND
REVERSIBLE BOTTOM BOARD
TOP BAR
FRAME FOR FULL SUPER
END BAR
BOTTOM BAR
DEPTH OF FRAMES TO FIT:
9⅝" SUPER - 9⅛" FRAME
6⅝" SUPER - 6⅛" FRAME
5⅛" SUPER - 5⅝" FRAME
NO SCALE
COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS
BEEHIVE AND FRAME
OR '75 6231 SHEET 1 OF 1
BASED ON: OREGON STATE UNIV. PLAN NO. BP 116

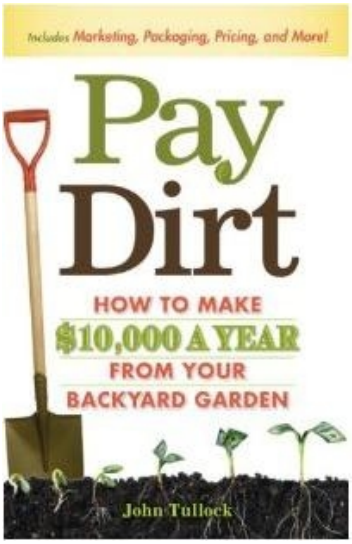
Recommended Books:

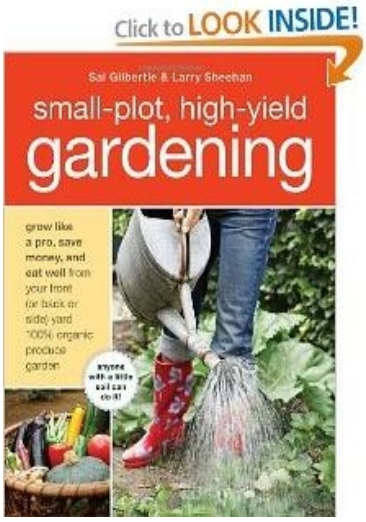

Click to LOOK INSIDE!
BACK TO BASICS
The Complete Guide to
BEEKEEPING FOR FUN & PROFIT
Everything You Need to Know Explained Simply

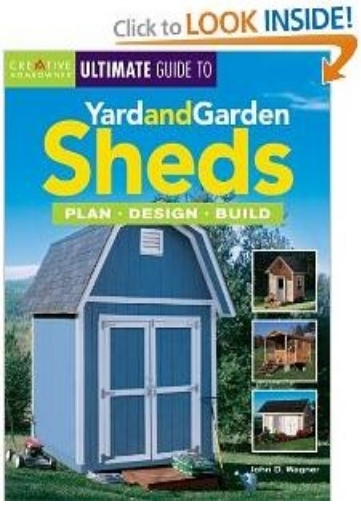


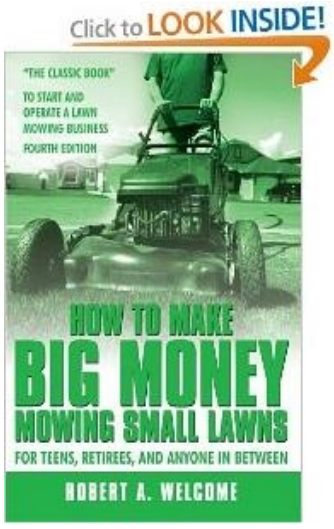


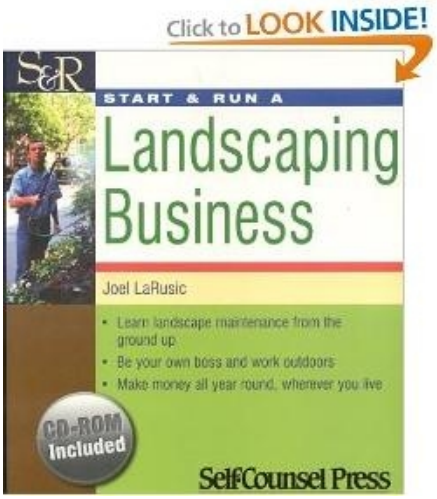




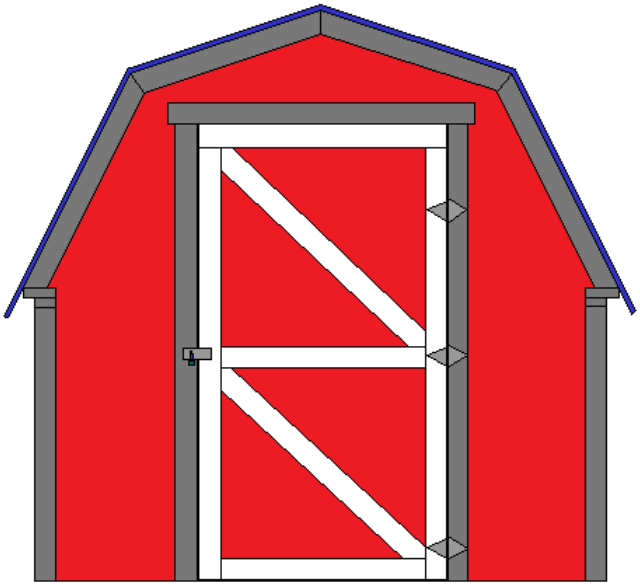








Shed building



I got married while in college and needed extra money fast. I decided to start a wood working business and needed a work shop shed so I got some free plans and built one like the one in the picture above. My neighbors watched me build the shed and asked me to build them one and soon I was building sheds for half the town. It paid a whole lot better than my woodworking ever paid! People need sheds and store purchased sheds are expensive. You can build an 8x8 gambrel shed from all new materials for under $500 and they sell for $1000 to $1200 easy.

Gambrel roof sheds like the one shown are very popular but gable roof sheds and slant roof sheds are also desirable. You can do custom designs for people or stick with the basic designs everyone uses.

To get started I had the customer pay half up front for materials and half upon completion. I provided the shed on 4x4 skids and it was not painted or stained unless the owner paid more for that service. Once I started making money I would pre-build all of the frame but not attach any panels so I could haul it all in my trailer and set up a complete shed in less than 2 hours. Total build time start to finish was under 5 hours.

I charged $800 for an 8x8 shed and at that time material was cheaper and I was broke but check on prices for commercial sheds in your area and materials and I bet you can undercut their price by 30% and provide free delivery and setup and still make a lot of money.

Basic tools for shed building are skill saw, jig saw, hammer, power drill, level, and tape measure. These sheds sell themselves and I would build one for yourself first and put it in the front yard next to your road with a sign on it that says sheds for sale and your price. You will probably have your first sale by days end!

Additional money can be made for painting, installing shelves or work bench, and installing windows.

8x8 foot sheds are a very popular size but you can expand into larger sizes and different designs as you go.

Use only good quality materials and I recommend T1-11 siding and Tamco 30 year shingles. Outdoor hinges and a hasp lock should be included. 4x4 skids for the base are sturdy and allows shed to be moved if necessary.

A good picture of a completed shed from different angles and description and price placed on flyers around town will get you all kinds of business. This business goes very well with yard care and handyman business.

Day Laborer

This is a generic business that just about anyone can get in to and all you need is the ability to follow directions and get the job done.

There are employment services that hire people as day laborers or Temps and you can go that direction or just let people know that you are willing to do any odd jobs they may need done.

We have a homesteader here that started a business by painting Busy Bee Services on his truck and advertising on flyers that he would do just about any manual labor job which includes cleaning gutters, minor repairs , building fences, ditch digging, fixing and building stuff.

We have another homesteader here that runs a business called Rent-a-Man. He also does manual labor jobs and does a lot of work hauling off trash, moving furniture and cleaning out garages.

You may need some basic tools and a truck for this business but if you don't mind doing physical labor there are lots of people that need you.

Farm Labor

If you live in farm country you can probably start a business offering your labor to the farmers that always need hands at harvest time. Be aware this can be hard work and dangerous so know what you are getting in to.

Around here we have farmers that need helping feeding animals, milking, and especially at hay harvesting time.

You can also advertise as a farm sitter which is someone that takes care of basic farm chores like feeding animals while the owner is away on vacation or emergency.

House or pet sitting

Many people have pets, plants and house chores that they do not want neglected while on vacation and you can make some good money taking care of their homes and pets while they are away.

Most people want to see references before hiring for this job so start with people you know like friends and family and have them write a reference to use for future jobs.

Hobby Businesses

If you are an artist, musician, photographer, fisherman, hunter, craft person, or can learn to do a craft very well you should have no problem making a business from your hobby.

Your market may be local and there are consignment craft stores in most towns that only charge a small amount to display your stuff and maybe a percentage of the sale.

You can also sell your items on the internet through Ebay and Amazon etc. I sell my ebooks and printed books through Ebay and Amazon and self publish through www.Lulu.com

Your crafts must be unique and not just the same thing everyone makes. People expect fine quality and materials in crafts so there is some upfront expense but once established it pays off big.

Some of the homesteader ladies I know make a very good living making homemade quilts, candles, and decorative crafts. They have refined their skills and can turn these out quickly.

If your hobby is playing an instrument you can make a good living giving lessons or performing at local clubs and events. Weddings like live music or polish your DJ skills. Karaoke is also good.

If your hobby is fishing, hunting, kayaking, skiing, river rafting or 4 wheeling there are many people that want a guide or someone to take them on an adventure trip. You can supplement this by selling the equipment they would need to go with the adventure. Take many pictures of them on their adventure and sell them a memories booklet and use the photos for your advertising.

There is a homesteader here that just gives guided river rafting tours. He has a large commercial 9 person raft and takes them down our local river about 30 miles across some fairly good rapids. They stop for lunch and take lots of pictures and he charges $50 per person for a 4 hour trip. He is booked solid from June to September.

If you area great cook consider a catering business, cake decorating or making meals for shut-ins. You will probably need a food handlers permit for this business. We have two ladies here that make up a nice hot sack lunch and delivers it directly to the oil wells and other businesses where people can't leave to get a meal.

If you are a good photographer you can make money from your own studio or provide services as a wedding photographer. You can also create photo books of vacation tours or special events to sell. One guy I know takes one great vacation to a unique place each year and takes pictures and writes a short pamphlet of his vacation that he sells on his website. He makes more than enough to pay for his next vacation.

If you have sports skills you can make money as a personal trainer in whatever sport you chose. The average sports trainer makes $50 an hour. It helps to have the equipment they may need to train and people are paying for positive encouragement so keep it positive no matter what.

Internet Businesses

Any business can be made better by using the internet. Set up a website to advertise your business and learn how to use search engine submission programs to get your website noticed.

You can also make money directly by using the internet without having a business license or any real products to sell. Affiliate programs allows anyone with a website to advertise their products and you get paid a percentage if a customer clicks on their ad and buys the product.

These affiliate programs work best if you have lots of visitors to your website and that means your website must have new information and updates at least once a week to keep people coming back.

Some of the best affiliate programs are Google addsense, Amazon, and Commission Junction.

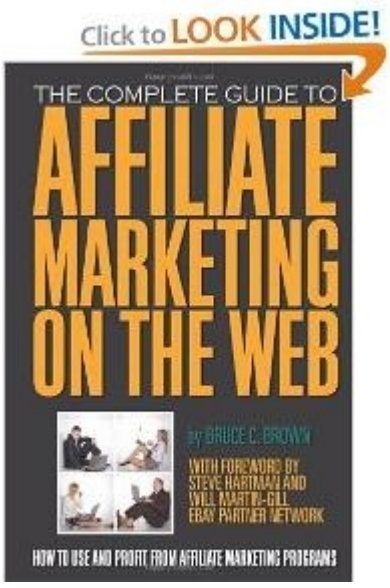
I have been an Amazon affiliate for three years now and as you have read this book you have probably clicked on a product picture that took you to Amazon for prices and information.

If you buy that product I get a small percentage of the sale of about 6%. The great part is Amazon stores a cookie on your system and if you buy any product in the next 30 days from Amazon I will get a percentage of that sale as well. It doesn't matter what product you buy and my commission does not affect your purchase in any way and does not increase the price you pay.

I also use Google adsense on my websites so if you click on one of these ads I get paid a small amount just because you clicked and you don't even have to buy anything.

Now these internet sales may not amount to much for each individual click or sale but when you have many hundreds or thousands of people visiting your websites and clicking on ads it can very quickly amount to a nice side income. I average $300 a month just from affiliate income.

You will need to do some additional research on affiliate programs before starting and I suggest these book: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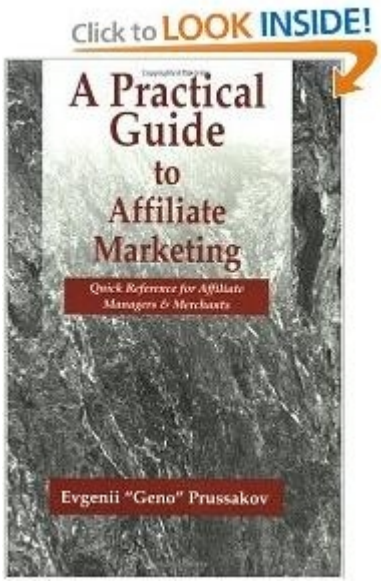
THE COMPLETE GUIDE TO
AFFILIATE MARKETING ON THE WEB
by BRUCE C. BROWN
WITH FOREWORD BY STEVE HARTMAN AND WILL MARTIN-GILL EBAY PARTNER NETWORK
HOW TO USE AND PROFIT FROM AFFILIATE MARKETING PROGRAMS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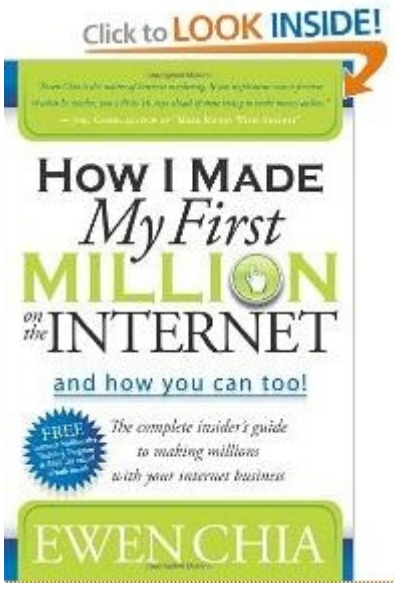
A Practical Guide to Affiliate Marketing
Quick Reference for Affiliate Managers & Merchants
Evgenii "Geno" Prussakov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and how you can too!
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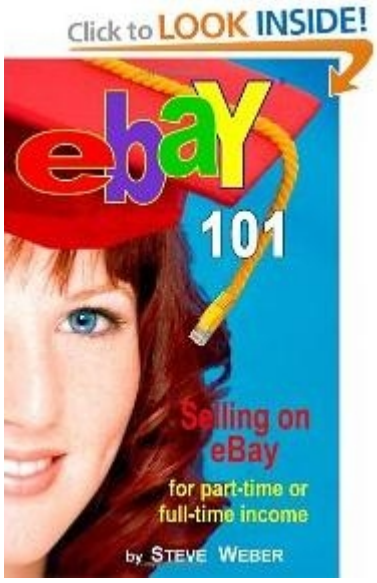
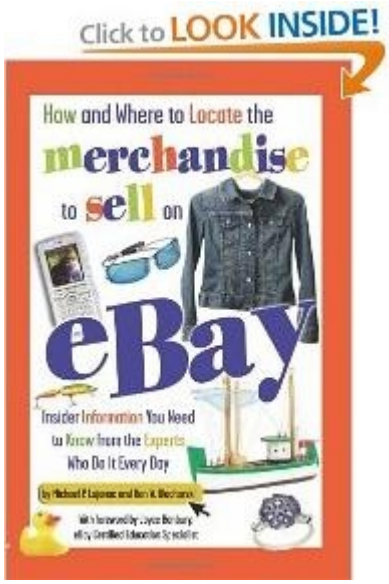
The complete insider's guide to making millions with your internet business
EWEN CHIA

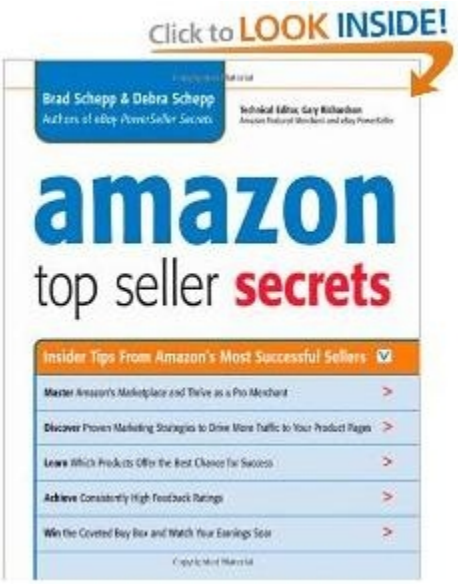
Direct Internet Sales

I have sold my books and other products very successfully using the internet and the biggest websites for selling stuff is Amazon and Ebay and I use both.

Direct selling means you have a product and a way to ship that product to your customers. For Ebay you handle all the shipping but with Amazon you ship to them and they ship to the customer.




Click to LOOK INSIDE!
How and Where to Locate the merchandise to sell on eBay
Insider Information You Need to Know from the Experts Who Do It Every Day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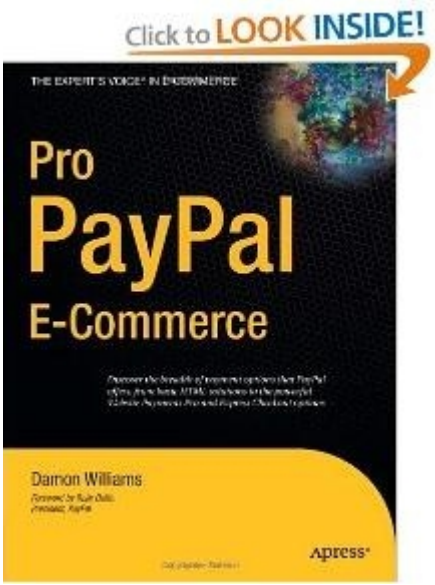
Brad Schepp & Debra Schepp
amazon top seller secrets
Insider Tips From Amazon's Most Successful Sellers

If you want to sell directly from your own website and cut out the middleman you will need a way to collect payments and most people use debit or credit cards to pay these days.

The best service I have found and the one I use is PayPal:



You will need to set up an account with Paypal and they allow you to place pay buttons on your website. They handle the transaction and the money is deposited immediately to your paypal debit card so you have access to it. PayPal debit uses Visa so it works everywhere.

Paypal charges a percentage for the transaction but it is worth it if you want to be able to accept instant credit card transactions.

I have used PayPal for over 10 years for my business and I have never had a single problem that was not resolved quickly!

Get more info on PayPal here: https://www.paypal.com/

Multiple Streams of Income

Most people are used to working for someone else and getting a pay check that they use to pay their bills. Being in business is very different and you will not be getting a single paycheck and your monthly income may vary a lot from month to month making it harder to plan your expenses.

You may have a business that is just seasonal or temporary and that means you may not have steady income.

My pest control business is like that and I make most of my income in just 8 months a year. I have learned to put away my savings from that work to carry me through the months I do not work.

I have also learned that having multiple streams of income can make you as much if not more than just one stream and if you lose that one stream you have nothing to fall back on while if you have multiple streams of income you will have enough to tide you over while you get back on your feet.

My multiple streams are my main business of pest control, income from my books like this one, and click and affiliate marketing. I also make some income from my homestead selling eggs and rabbits.

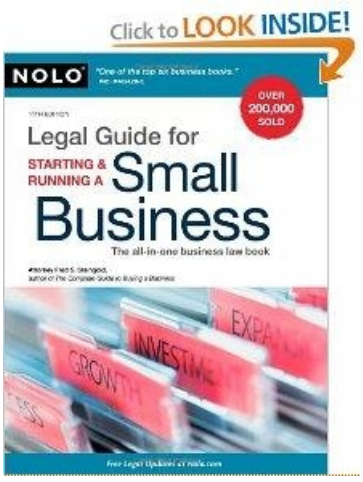
My side businesses don't take up much time and yet they bring in a nice monthly income and generally I never have to dip in to my savings and retirement money from my main business.

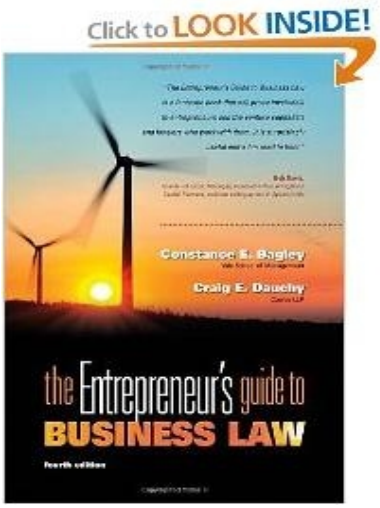
Eventually I will get too old and beat up to do pest control (already there) but my other side businesses do not require any physical labor and as long as I have an internet connection I will be able to make enough money to survive.

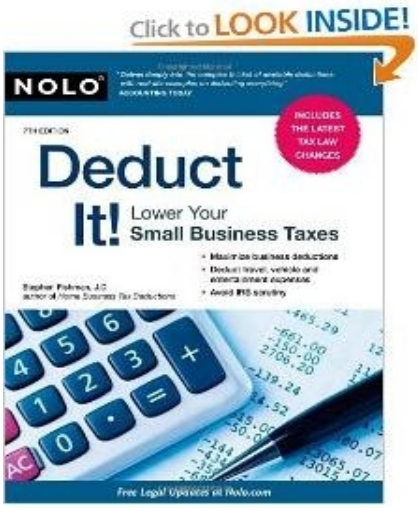
I do not rely on social security being around when I am old enough to collect so I have been putting away enough in savings to make it possible to retire at 55 and never have to work again. With no house payments and monthly bills that takes a lot less money than you would think!

So that is my business story and I hope I have helped you to see that starting a business is easy and possible for anyone and you will be inspired to try and keep trying until you are successful.

I am not going to cover taxes or laws in this section because that is not my expertise and if I told you what I thought about either you might get the wrong idea. Suffice it to say that there are taxes and laws regulating even homesteader businesses and it is in your best interest to know what those regulations are. Here are some books that might help:







Homestead Security and Communication

One of the questions I get asked a lot is if I feel isolated and and out of touch with society living an off-grid homesteader and my answer is- only when I want to be!

It is true in years past that moving off-grid away from society meant not seeing people or being able to have social contact but with today's technology there is no reason you have to go without social interaction unless you decide to live way-way off-grid.

I recommend building your homestead within an hours drive of a town because you will need to buy supplies occasionally and may need medicines and health care. If you have an accident or emergency and you need help you could be in trouble if you are living far away from a town.

You should also have a reliable form of transportation and I have learned to have back-up transportation in case one fails. I have my truck but also a motorcycle that can be used if the truck breaks down.

You might not want neighbors living near you but t is still a good idea to know at least a few people in the vicinity by name and have their phone numbers and share your number in case you or they need help in an emergency.

If you don't have a land line you should have a cell phone and cell phone service is available just about everywhere. Make sure a cell phone works on any land you are considering buying.

They make boosters that will give you a better connection and this will also boost your wifi internet if you are using that system.

Wifi Booster

Cell Phone Booster

You can also get satellite phone receivers that can get a signal just about anywhere: Sat Phones

I have cell phone and wifi service at my cabin and this allows me to run my business, talk to friends and family, and keep up with the gossip and news. Laptop computers do not use much power (about 30 watts) and laptops, cell phones and other gadgets can be run just fine off a small solar electric system. I also have a small inkjet printer and a game system that I run fine off solar.

I do recommend everyone have an emergency weather radio and they make nice ones now that also have two way radios built in and can be charged by cranking or charged from your solar.

Two way weather radio

Ham Radio

If you are too far away to get cell phone service you should probably have a Ham radio and learn the regulations for operating one. In an emergency a Ham radio could save your life.

Now-a-days we have digital flat screen tvs and micro video players that use a lot less power than the old conventional tvs so there is no reason you have to go without some entertainment if you want.

I use an 18" flat screen tv and it takes about 75 watts of power and I can watch it all night without draining my batteries- if only something good was on!

Most towns still have TV stations broadcast on the airwaves and all you need is a roof antennae but if not you can still get TV using a satellite receiver that can be used anywhere you can aim it at the sky towards the satellite. I use a roof antennae and get about 10 channels and some in HD digital.

You can even get satellite broadband receivers so you can use the internet and communicate just about anywhere in the world where you can aim it at a satellite: Broadband satellite receiver

So there really isn't any reason to feel un-secure and isolated even in an off-grid home or go without any of the communication tools you would use in an on-grid home. I run two internet business using my laptop and wifi and my pest control business relies on cell phone service and I have all the gadgets most people have in their homes. The only difference is mine are powered by the sun.

About the only thing I do different is I make sure my cell phone is charged if I know a big winter storm is coming that might reduce my solar power temporarily and I reduce my power use on very cloudy overcast days. My system is only 570 watts and still runs everything I need.

Being off-grid may also inspire you to learn to entertain yourself and your family and I learned to play guitar and write songs and play harmonica. I also do go to town at least a few times a week and I have friends I visit and social events I attend for human companionship. My girlfriend lives in town and we get together and sometimes she stays with me and occasionally I stay with her for a change.

You will only be as isolated as you want to be and being able to get away from people is wonderful!

Safety

I recommend you have a well stocked professional first aid kit with supplies for splinting and controlling bleeding because if you are far away from a town you may need to save your own life or your family or neighbors lives.

I would also suggest taking a First aid course and maybe the EMT training if you are likely to see accidents.

I was an EMT and professional rescuer trainer in college and that training has come in handy many times in my life.

Survival Supplies

Many things can happen that may make it necessary for you to stay on your homestead for extended periods and not be able to get to town. Bad weather, earthquakes, road closures, man made disasters, floods, fires to just name a few or it could be the result of your vehicle breaking down etc.

So you should always have a food and water storage system and I recommend enough food to last at least 6 months per person and 1 year would be even better. Water can be stored in plastic 55 gallon barrels if you do not have a secure water source and the recommendation is 1 gallon per person per day for drinking and washing.

You should have a secure water source on your property and this book explains how to drill a well and collect rainwater. You should also know where fresh water sources are around your homestead like other wells, springs, lakes and rivers in case your own water supply fails.

Food can be stored and dry goods and canned foods can be stored in plastic bins or under beds or consider building a secure cellar or food storage shed: Root Cellar Plans

Chickens, rabbits, goats and other farm animals will provide fresh but you may need to free range them in the event you can not get to town to buy feed. Animal raising ideas are included in this book.

If you will be growing I garden (you should) then you should also learn how to preserve your excess and how to smoke, jerk and dry foods that can be stored for an emergency or just regular use. It is beyond the scope of this book to teach those skills so learn from the experts: Preserving Food

If you take regular life sustaining medicines you might want to consider having extra on hand in the event you can not get to a pharmacy. Vitamins and over the counter pain relievers can be purchased in bulk and stored for emergencies.

Basic necessary supplies like toilet paper, ladies sanitary needs, powder baby formula, cloth diapers, cleaning supplies should also be included in your emergency storage.

For more info on emergency storage try some of these books: Emergency Preparedness

Security

Living off grid can mean there are no cops around when you need one. I suggest you get to know the closest sheriff,s, highway patrol unit and fire department in your area and have their numbers on speed dial just in case and you should have your address memorized with good directions that the rescuers can follow quickly to get to your homestead especially if you are out in the boonies!

A few years back I was burning some trash in a barrel and a big wind gust kicked out an ember that quickly caught some weeds on fire. Within a few minutes my whole yard and my neighbors yards were going up in flames and there was no way I could stop it. I called 911 on the cell phone and requested help from the fire department but it still took them over 30 minutes to find my place and we only narrowly escaped burning down two homes. These things happen fast so be prepared.

You should have a charged fire extinguisher in your home, fire and smoke detectors and a carbon monoxide detector. I also suggest a gas or electric pump hooked to your water supply for an outside fire.

In the event of a forest fire in your area follow the directions of the fire crew and I would suggest keeping trees and weeds far enough back from your home to create a fire break. If the fire crew says evacuate take your supplies and do it because nothing you own is worth losing your life over.

Because your homestead may be off the beaten path you may be more likely to have unwanted visitors and vandals and thieves target cabins and remote homes for easy pickings. You might also have 4 footed predators like bears, wolves, coyotes, skunks, and raccoons that can do damage.

For those reasons you may want to have a rifle or handgun for self defense, predator control and possibly hunting. Take a gun safety course and practice often to keep your skills sharp.

I recommend a simple 22 rifle for most homesteads would be sufficient for protection and predator control or used for hunting small game. Handguns are less accurate at any distance but can be concealed easier if you want to take it with you on trips.

To prevent vandals and thieves use some common sense and lock your stuff up and no trespassing signs and a big hungry dog will deter most criminals without the need for a gun. I keep two large black mongrel dogs on my homestead to alert me of any trespassers and for hunting and they are worth their weight in gold.

You may also want to try your luck with a crossbow or compound bow for hunting and get some fishing supplies for a hobby that will become a very valuable skill when you need food for the table.

I am a long time hunter and fisherman and can supply most of my meat needs with those skills just by wandering around my local countryside. We have deer, rabbits, pheasants, and other game all over where I live and good fishing rivers and lakes within a few miles of my cabin.

Making Your Homestead Self-Sufficient

My goal in building my homestead and choosing my homesteader lifestyle has always been to be more self-sufficient. I was not looking to be completely self-sufficient as in producing everything I need on my homestead but towards reducing what I needed to buy and using my homestead lifestyle to produce enough income to buy the things I do not produce.

I stopped working for other people over 15 years ago and because I have no house payments and no utility bills and few expenses I have been able to support myself very well from my small businesses and the income I make from my homestead.

You may not be into homesteading as a lifestyle but I hope you consider the benefits that come with using your land to be more self-sufficient.

Any piece of land can be used for growing food and raising animals and not only do you provide fresh healthier food for your table and family but your excess can be sold or traded to pay for other things you need.

<u>Raising Animals</u>

Unless you want to be a large scale farmer and have a lot of time and acreage for raising crops and herds of animals I would stick to a small scale plan and on just an acre you can raise almost all the food for a family of 5.

I raise rabbits for meat and the fur can be used for leather crafts and droppings become fertilizer for your garden or can even be sold.

I raise chickens for eggs, meat and fertilizer and feathers can be used for crafts like fly tying.

I have raised goats for meat and milk and pigs for meat and fertilizer and these can also be raised very successfully on a small homestead.

You might also consider one of the miniature cow breeds that produce ¾ the meat as a full size cow on ½ the amount of feed.

Chickens

I grew up raising chickens and they are one of the easiest animals to tend and all you need is a cage or chicken coop that is protected from the weather, some nest boxes, a waterer and some feed.

I know people that keep a few hens in cages in their garage just for the fresh eggs though I suggest an outside run so your chickens can get some sunshine, scratch and catch bugs.

You can order chicks by mail or pick them up at your local farm supply store in the spring. You will need a brooder to keep them warm which is just a shallow box or a small kids wading pool covered with some fine netting and a red brood lamp to keep them warm. Chicks need chick mash and do not feed them anything except chick mash until they are fully feathered out.

Once the chicks are feathered out they are ready for a coop or cage. A simple coop can be made from scrap lumber or if you have the space a movable coop called a Chicken Tractor will allow your chickens to get more greens and bugs in their diet while spreading the free fertilizer around.

You can also free range your chickens and they won't stray far but with the large number of dogs, cats and other predators everywhere you may lose all your chickens to an animals next meal.

You do not need a rooster unless you plan on hatching eggs and a rooster will crow and may make a nuisance of themselves as they get older and want to fight and bother the hens. I have the scars to prove it!

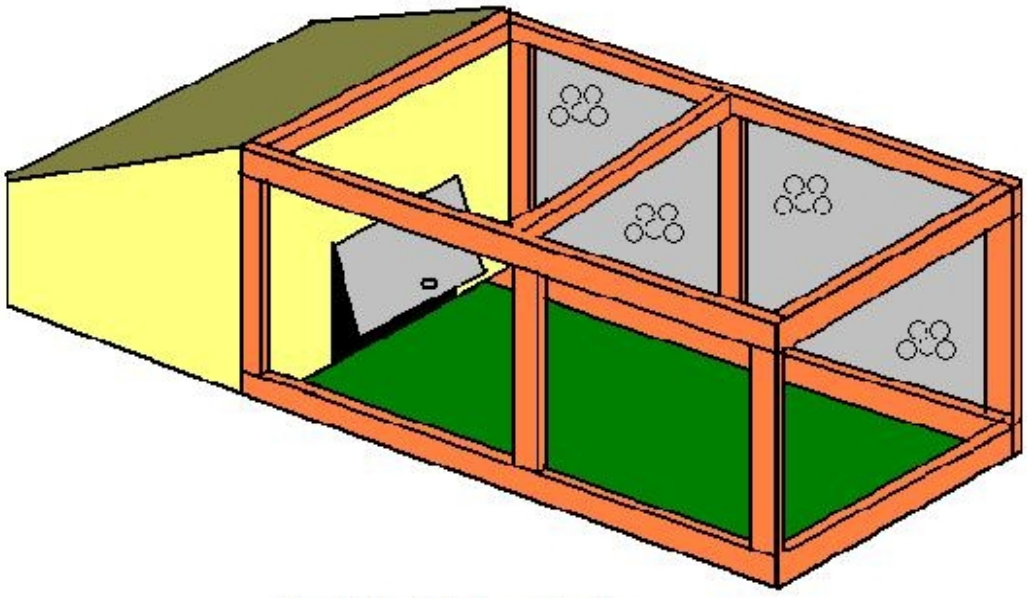
Once your chickens are about a year old they will begin laying eggs and the first eggs may be soft and funny looking but that will fix itself. A good hen will lay an egg almost every day. And you may soon have more eggs than you know what to do with. That is when you consider selling or trading those eggs to friends and neighbors for other things you need and chicken raising can be completely self-sufficient if you sell the excess eggs, meat and fertilizer to pay for the feed.

Eggs do not have to be refrigerated if you are using them within a few days and just brush them off or rinse the very dirty ones but do not scrub them or you may force dirt through the shell.

Chickens are relatively healthy with few diseases but get a book on raising chickens and common ailments or do some research on the internet and choose a breed that provides both meat and eggs.

Portable Chicken Tractor For under $50

What is a portable chicken tractor ?
If you have ever raised or been around chickens you know they can devour their weight in bugs and grasses and do a great job of tilling the soil with their constant scratching for food. When you build this simple portable chicken tractor you will be able to harness this power and make it possible to free range your chickens while keeping them safe from predators.



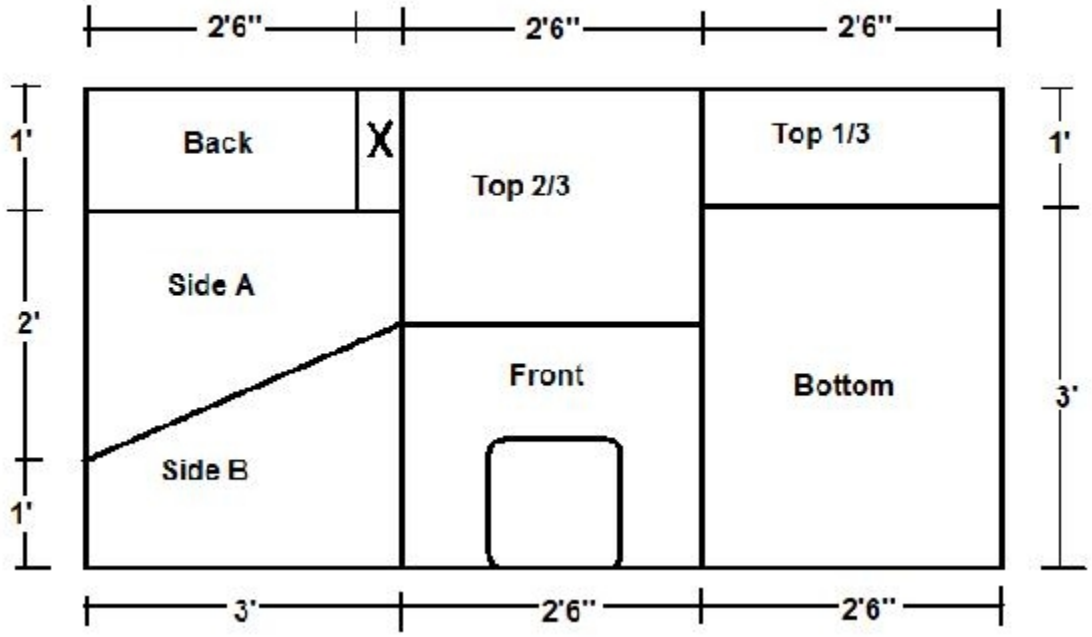
Portable Chicken Tractor

How it works: This portable pen is big enough to hold 3 big chickens or 4 small bantams, a nest box for eggs, and a water container. The attached run gives your chickens access to fresh green food and bugs that happen to come too close. The tractor is light enough that one person can easily pick it up from the front and drag it to a new spot every few days to give the chickens a new spot to eat and scratch. Chicken manure is good for soil and the chickens will till up the soil making it better for growing things. Your chickens will be happier, safer, and healthier. With free range food your eggs will taste better, and your chicken food bill will be less.

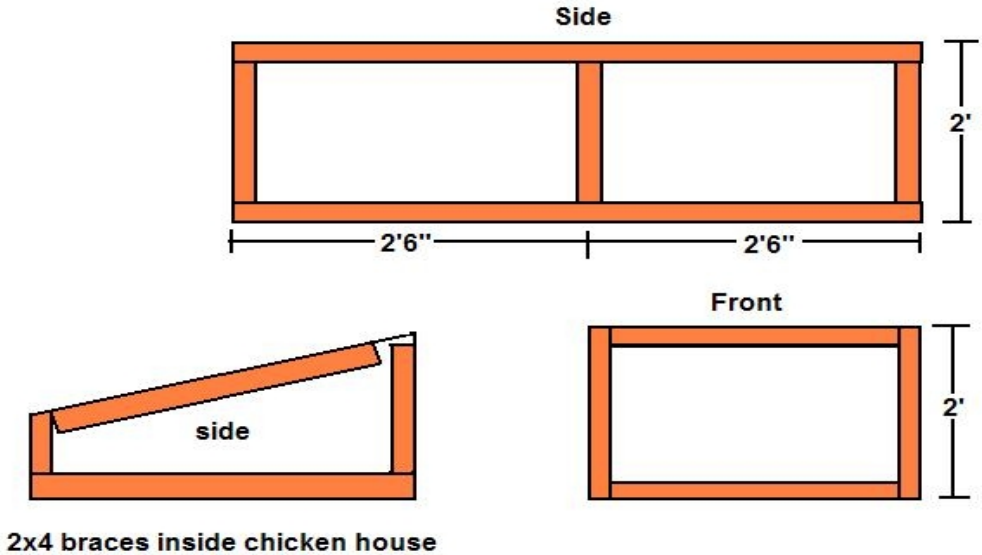
Materials needed: One 4x8 sheet plywood or wafer board, Five 2x4x8s, a couple of heavy duty hinges, a roll of chicken wire, and a handful of wood screws. These materials can be purchased new for under $50 or scrounge around and recycle some materials.

Step #1: Lay out your tractor house as shown and cut out parts with a jig saw or hand saw:

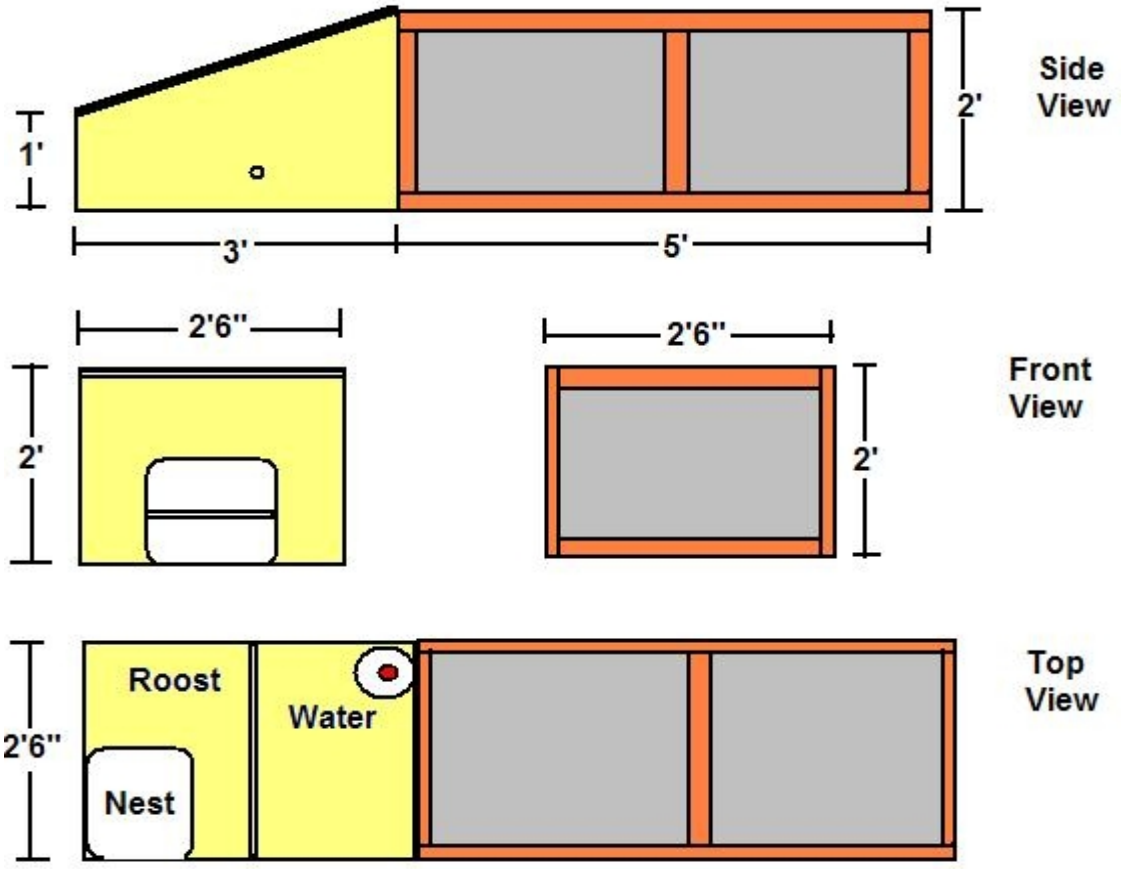
Portable Chicken Tractor



Step #2: Cut your 2x4s and build your frame as shown here:



2x4 braces inside chicken house



Step #3: Build your tractor run and tractor house as shown here. Attach the front panel of the house to the run with wood screws the roof top 2/3rds panel is attached to the chicken house with screws. The roof top 1/3 panel is attached only with hinges so it can be opened to collect eggs and feed and water chickens.
Install a roost about 8 inches from the floor of chicken house and install a nesting box filed with clean straw or shavings.

Step #4: cut a 1 foot by 1 foot door in the front. Re-attach this cut out piece using two small hinges. Attach a piece of heavy twine to the bottom edge of the door and run it up through the top of the run and attach it to the wire. You can then open or close the door by pulling the string to let chickens in or out as you please.

Step #5: Enclose tractor run with chicken wire. I used 1 inch opening wire but you could use larger or smaller. If you are concerned about predator animals getting to your chickens I would suggest enclosing the bottom of the run as well as the sides and top. You can use some staples to secure the wire and snip off loose wire ends around the run to protect chickens from injury.

That's all there is to building this portable chicken tractor. Just keep your chickens well fed and watered and 3 hens will average 2 eggs every day. When the chickens have eaten most of the grass in their run just shoo them back into the house and drop the door, then grab the tractor by its front edge and drag it to another green spot. I move mine about once a week. If you can find a couple of old lawnmower wheels you can attach them to the rear corners of the tractor and this will make moving the tractor even easier.

There are hundreds of different chicken coop designs and here are free plans for ideas:

LINKS TO FREE COOP PLANS!

- http://www.Geocities.com
- http://www.motherearthnews.com
- http://www.thecozynest.com
- http://www.larryspoultry.com
- http://www.poultry.allotment.org.uk
- http://www.pvcplans.com
- http://www.organicgardening.com
- http://www.feathersite.com
- http://www.buildeazy.com
- http://www.poultryhelp.com
- http://www.braingarage.com
- http://www.geocities.com
- http://www.backyardchickens.com
- http://guineafowl.com
- http://www.ext.vt.edu

Videos for chicken coop building

http://www.youtube.com/watch?v=igAXk6fkH6U

http://www.youtube.com/watch?v=LMcUYFBuFyU

http://www.youtube.com/watch?v=M0rIdn_mgzg

http://www.youtube.com/watch?v=vsnLqHDiN9w

Raising Rabbits

Rabbits are also very easy to raise in a small space and because they are prolific breeders a few rabbits can keep a family in meat. Rabbit meat is low in fat and cholesterol and is healthier than red meat. Rabbit fur is great for crafting and rabbit fertilizer is great for the garden and can be used for raising worms.

If you want to make additional money from your rabbits they sell well at Easter and pet stores will also take your bunnies.

Rabbits are so well liked as pets that they are now as popular as dogs and cats for pedigree breeding You can buy rabbits at pet stores or look for a local breeder. There are many breeds and some are bred for looks and others for meat and ease of care.

Rabbits need a solid cage, waterer, feed box, salt lick and a nest box for the does. They can be tamed easily and some people let them run around their homes like other pets.

You will need a Buck for breeding or if you have friends with Rabbits you can usually borrow a Buck for a couple of days to service your does. To prevent inbreeding avoid using the same Buck for breeding to it's own offspring.

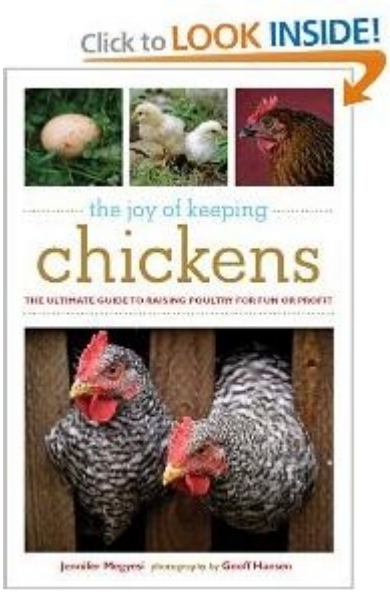
Because Rabbits like to chew wood I would recommend wire cages and you can build these your self from a roll of rabbit cage wire and cage clips available here:

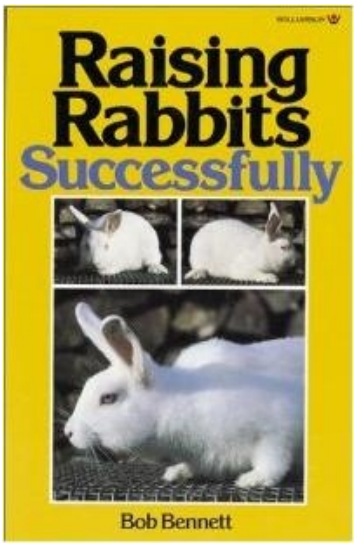
http://www.bassequipment.com/Default.aspx?TabId=10

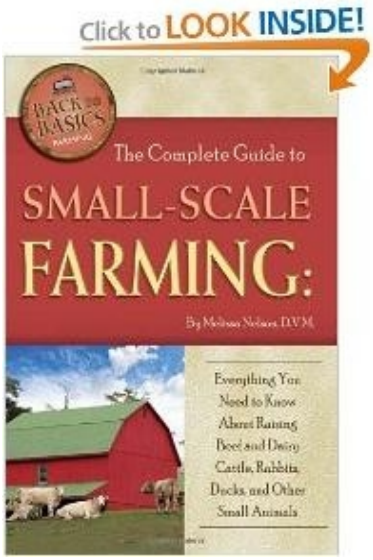
They sell the cage wire by the roll and you can get 100ft or 50ft rolls. A 50 ft roll will make two 3ft x 3ft cages similar to the one here:

Outdoor hutches need to be protected from the rain and drafts. Rabbits can handle the cold (fur coats) but drafts and a wet cage will kill them so build a good shelter. I keep my rabbit cages inside my chicken coop attached to a wall and that makes feeding convenient because anything the rabbits drop out of their cages the chickens quickly clean up and the rabbits are protected from the weather.

Recommended books:



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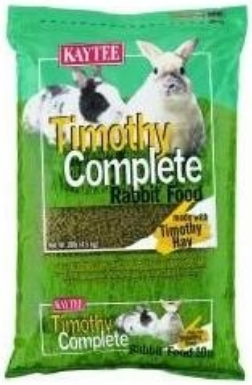
BACK TO BASICS
The Complete Guide to
SMALL-SCALE
FARMING:
Everything You Need to Know About Raising Beef and Dairy Cattle, Rabbits, Ducks, and Other Small Animals

Supplies:



Gardening for self-sufficiency

One of the great joys of having some land is the ability to grow things and growing a garden and fruit trees can provide a substantial part of your food needs and the excess can be traded or sold.

A garden provides fresh food that is healthier for your family than store bought food which has usually been treated with pesticides and other treatments to prevent spoiling and will provide you with a much wider variety of foods than what are available in stores.

You do not need a lot of space to grow a garden and most garden plants can be grown in just 1 square foot of space. Plants can also be grown in containers, raised boxes, and people in the city even grow gardens on balconies and rooftops of buildings.

You don't need a lot of skill to grow garden and I am living testimony to that because I am a lazy gardener that forgets to weed and water and yet my garden always forgives me and produces despite my best attempts to ignore it!

If your land does not have great soil you can still grow a garden but you may need to amend the soil by adding humus, compost and fertilizer. Only the first few inches of soil called topsoil has the necessary nutrients for plant growth and over time that topsoil is degraded by erosion from wind and water.

Learning as much as you can about your soil will help you decide what needs to be done to make it ideal for the plants you want to grow. If you can learn about your soil's texture, composition, drainage, acidity, and mineral density, you will avoid, up front, the disappointing results that can occur when your soil is unsuitable for your dream garden.

Soil Test #1: The Squeeze Test

One of the most basic characteristics of soil is its composition. In general, soils are classified as clay soils, sandy soils, or loamy soils. Clay is nutrient rich, but slow draining. Sand is quick draining, but has trouble retaining nutrients and moisture. Loam is generally considered to be ideal soil because it retains moisture and nutrients but doesn't stay soggy.

To determine your soil type, take a handful of moist (but not wet) soil from your garden, and give it a firm squeeze. Then, open your hand. One of three things will happen:

1. **It will hold its shape, and when you give it a light poke, it crumbles. Lucky you—this means you have luxurious loam!**
2. **It will hold its shape, and, when poked, sits stubbornly in your hand. This means you have clay soil.**
3. **It will fall apart as soon as you open your hand. This means you have sandy soil.**

Now that you know what type of soil you have, you can work on improving it.

Soil Test #2: The Percolation Test

It is also important to determine whether you have drainage problems or not. Some plants, such as certain culinary herbs, will eventually die if their roots stay too wet. To test your soil's drainage:

1. **Dig a hole about six inches wide and one foot deep.**
2. **Fill the hole with water and let it drain completely.**
3. **Fill it with water again.**
4. **Keep track of how long it takes for the water to drain.**

If the water takes more than four hours to drain, you have poor drainage.

Soil Test #3: The Worm Test

Worms are great indicators of the overall health of your soil, especially in terms of biological activity. If you have earthworms, chances are that you also have all of the beneficial microbes and bacteria that make for healthy soil and strong plants. To do the worm test:

1. **Be sure the soil has warmed to at least 55 degrees, and that it is at least somewhat moist, but not soaking wet.**
2. **Dig a hole one foot across and one foot deep. Place the soil on a tarp or piece of cardboard.**
3. **Sift through the soil with your hands as you place it back into the hole, counting the earthworms as you go.**

If you find at least ten worms, your soil is in pretty good shape. Less than that indicates that there may not be enough organic matter in your soil to support a healthy worm population, or that your soil is too acidic or alkaline.

Soil Test #4: Ph Test

The Ph (acidity level) of your soil has a large part to do with how well your plants grow. Ph is tested on a scale of zero to fourteen, with zero being very acidic and fourteen being very alkaline. Most plants grow best in soil with a fairly neutral Ph, between six and seven. When the Ph level is lower than five or higher than eight, plants just won't grow as well as they should.

Every home and garden center carries Ph test kits. These kits are fairly accurate, but you must make sure you follow the testing instructions precisely. Once you know whether your soil Ph is a problem or not, you can begin working to correct the problem.

If you find that you've done all of these tests, and amended the soil as needed to correct the issues, and your plants are still struggling along, the next step is to contact your local cooperative extension service. They will tell you how to go about collecting a soil sample and sending it into their lab for analysis. They will return a report that will alert you to any mineral deficiencies in your soil, as well as steps to correct the issues.

These tests are simple, inexpensive ways to ensure that your garden has the best foundation possible.

There are many different methods of gardening but here are the basics:

Plants need good soil full of nutrients. You can add top soil, humus, compost and fertilizer to amend the soil and the PH of soil can be adjusted using products available from your local garden supply.

If your soil is is so poor it is not worth fixing you can grow a garden in containers or raised grow boxes filled with topsoil you haul in.

You can see my raised garden boxes in this picture. I didn't want lawn in my front yard so I covered the ground with black plastic and built these 4x12 boxes that I fill with tomato, pepper, and and cucumber plants so I can pick a fresh salad right outside my door.

I plant marigolds and other flowers around the edges which attracts bees but also deters insects.

I water my garden from my greywater system and a drip irrigation rain water system.

Raised beds can be made from scrap lumber rock, cement block or even scrap metal as long as it holds the dirt in place.

Traditional garden beds involve tilling up to aerate and amending the soil already on your property and you must be careful that you do not create more erosion and lose valuable topsoil to wind and rain. Only till when you are ready to plant and add humus and compost to the soil to make it less prone to erosion.

You can till up your soil by shovel method or using a powered rototiller or hand powered tiller. When shoveling keep the shovel close to the ground to prevent the dirt from blowing away and break up the clods using the point of the shovel.

Building Soil in the Garden

The earth neither grows old or wears out if it is dunged. - Columella, circa 45 A.D

If you want to improve your soil and make it more suitable for your vegetable garden, you first have to figure out what you're dealing with. Is your soil sandy or clay-based? Is it too acidic or too alkaline? The way to answer these questions is to have your soil tested. There are do-it-yourself tests you can purchase or you can hire a private soil testing laboratory or your local cooperative extension office to test it. Not only will the professional soil tester tell you the composition of your soil, but the lab will usually be able to make recommendations on how to improve it.

In addition to measuring the pH level of your soil -- how acidic or alkaline it is -- tests also look at how much calcium, organic matter, magnesium, nitrogen, phosphorus, potassium, sodium , sulfur and trace minerals it contains.

When it comes to the pH scale, neutral refers to soil with a pH of 7.0. Anything above a 7.0 is considered alkaline and anything below a 7.0 is considered acidic. Most plants prefer slightly acidic to neutral soil (from 6.0 to 7.0).

If your soil is too acidic, you need to add alkaline material, such as ground limestone. For soil that is too alkaline, you need to add something that is acidic. Most gardeners use elemental sulphor.

Once you've corrected the pH of your soil, you'll also probably want to add organic matter. According to the University of Georgia Cooperative Extension, "an ideal soil would have equal parts of sand (0.02 to 2.0 millimeters), silt (0.002 to 0.02 millimeters) and clay (0 to 0.002 millimeters) and contain about 5 percent organic matter."

Also aerate your soil. Dig down 10 to 12 inches and turn the soil over. You can do this with a spade or a garden fork. The University of Georgia recommends digging a trench 1-foot-deep on one side of your garden. Push the soil from that trench to the outer boundary. Then dig another ditch right next to it and fill in the first ditch with the dirt from the second ditch. Proceed across the garden. You can also use a tractor-mounted plow or a Rototiller set to the deepest depth. While you're turning over the soil, add organic matter so it gets down to the root level of the plants, so your vegetables can have access to the nutrients that you are adding.

How much organic matter you will have to add depends on your soil's composition, the size of your garden and your climate. For example, sandy soils in warmer climates may need as much as 2,300 to 4,600 pounds per 1,000 square feet, according to the University of Georgia. Heavier soils in cooler climates with less rainfall may need as little as 200 pounds per 1,000 square feet.

You'll want to fertilize your garden plot twice if you can: once before planting and then again in the middle of your growing season. For mid-season fertilizing, it's easiest to do what's known as "side dressing," which means adding dry fertilizers, compost or other organic soil amendments to the side of your plants. To side dress, you dig a narrow furrow one to three inches deep at the plant's drip line or six inches from the plant base, whichever is greater. You then sprinkle the amendment into the furrow and cover it up with soil.

Composting

Compost is a great way to add organic material to your garden and, if you make your own, reduce organic waste from your home and kitchen. Compost also attracts earthworms and other beneficial organisms. It provides nutrients to your vegetables and it will improve your soil.

Get your composting off to a great start with a compost tumbler and plans are included in this book.

You'll want to begin the composting process using a mixture of "green" (wet, high-nitrogen) materials combined with "brown" (dry, high carbon) materials. Green items include: coffee grounds, chopped leaves or grass clippings, eggs or eggshells, fruit wastes and grains, manure, seaweed, vegetable scraps, weeds. Brown items consist of: corncobs and cornstalks, hay, nutshells, paper, pine needles, sawdust, straw.

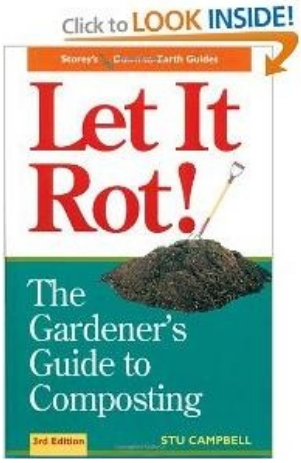
Do not compost:
• Meat scraps and trash containing a lot of fat
• Colored paper
• Diseased plants
• Pet droppings
• Plants sprayed with synthetic chemicals (pesticides, herbicides)

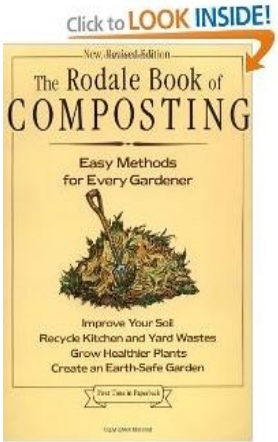
You'll know that the decomposition process is "done" when you can't distinguish any of the raw materials. It should smell and feel like rich soil.

To build your compost pile, which should be an annual event, accumulate organic material. Your pile can be on open ground or in a bin constructed from cinder blocks, rough boards or wire. The sides of the bin should be permeable and shouldn't be air tight or water proof. Autumn can be a great time to start composting since fallen leaves are plentiful.

Green Manures

Green manure is a crop that is grown and then mixed in with the soil to increase the soil's organic matter content. Green manure crops include buckwheat, clover, soybeans or winter rye. The advantages of green manure include: increasing organic matter in the soil and increasing nutrients for plants. Green manure can also fight back against certain diseases and pests such as nematodes. (Nematodes are microscopic worms that feed on certain plant roots and can weaken plants.)

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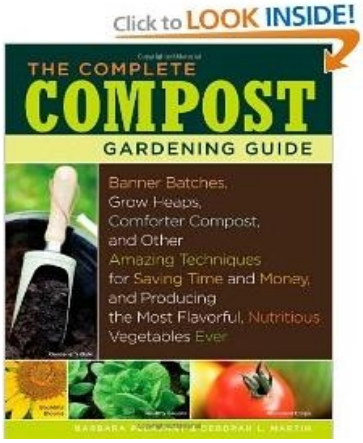
Recycle Kitchen and Yard Wastes
Grow Healthier Plants
Create an Earth-Safe Garden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THE COMPLETE COMPOST
GARDENING GUIDE
Banner Batches, Grow Heaps, Comforter Compost, and Other Amazing Techniques for Saving Time and Money, and Producing the Most Flavorful, Nutritious Vegetables Ever

You can greatly reduce weeds building a layer of mulch around the plants:

Organic Mulches

Mulches made from plant material are organic mulches. Over time, organic mulches will decompose and become part of the soil. This is a great advantage, because this decomposition adds organic matter to your soil, helping the soil to better retain water and nutrients-giving you healthier plants. This means, however, that organic mulches will have to be replenished from time to time.

- **Bark. Bark mulches are usually made from the by-products of pine, cypress, or hardwood logs. Most common are shredded bark and bark chunks. Bark mulches resist compaction, will not blow away, are very attractive, and are readily available. Some shredded barks, such as cypress, decompose slowly. Bark chunks (also called nuggets or decorative bark) decompose most slowly but do tend to wash away.**

- **Wood chips. Wood chips are made from many different kinds of trees. Wood chips make an excellent mulch that resists compaction, stays put, and weathers to an attractive silvery-gray color. In addition, they are often available from municipalities or utility companies for little or no cost. However, such "bargain" mulches are likely to contain seeds from trees and other plants that can sprout and create weed problems. Also beware of such mulches that have not been properly aged or composted. Mulch that has not been aged can be toxic to plants due to the formation of organic acids during the decomposition process, and, if placed too close to tender stems, will harm or kill plants. Purchasing mulch from a reputable dealer who has monitored the decomposition process to achieve a high quality, aged product will do a lot to ensure that your valuable plants will not be harmed.**

- **Sawdust. Sawdust is often readily available and may be helpful in acidifying the soil around rhododendrons and other acid- loving plants. Sawdust is a poor choice in most situations, however, as weed seeds easily sprout in the mulch. It also tends to cake, making it harder for water to soak into the ground. Sawdust is low in nitrogen, so it robs nitrogen from the soil as it decomposes. Therefore, more nitrogen fertilizer may be needed. A 3- to 6-inch layer of sawdust does work well, however, for mulching pathways.**

- **Straw. Straw makes a good winter mulch or mulch for the vegetable garden. It is inexpensive, suppresses weeds, conserves moisture, and insulates well. On the other hand, it is not very attractive, may contain crop seeds, and is extremely flammable. It is important to purchase "straw" rather than "hay," as hay contains many weed seeds. Mulch 6 to 8 inches deep.**

- **Pine straw. Pine needles are attractive, decompose slowly, resist compaction, and are easy to work with. They are often available commercially or are free if you have pine trees on your property.**

- **Shredded leaves. Leaves that have been shredded with a composting mower are sometimes used as a summer mulch, although they decompose very quickly. Whole leaves can be used instead, but they tend to mat together and block water movement into the soil.**

- **Newspaper. Three layers of newspaper can effectively keep down weeds, especially in the vegetable garden. To keep the paper from blowing away, weight it down using another mulch or other means. Shredded newspaper also works well.**

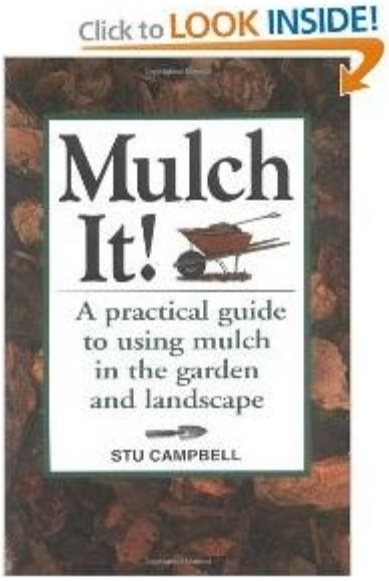
Inorganic Mulches

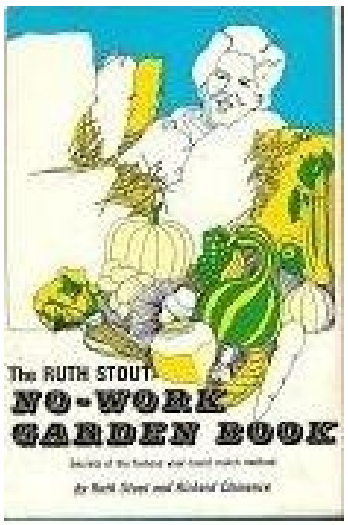
Inorganic mulches, often of stone or plastics, tend to stay in place, do not rob the soil of nitrogen, and do not harbor weed seeds. However, they have numerous disadvantages when used in the garden. Stone mulches can migrate down into the soil in time, making future digging difficult. Light-colored stones can reflect heat onto plants, scorching sensitive plants. Stones also tend to work free of beds and can be thrown by lawn mowers, potentially causing injury. Perhaps the greatest disadvantage, however, is that these mulches do not contribute organic matter to your soil.

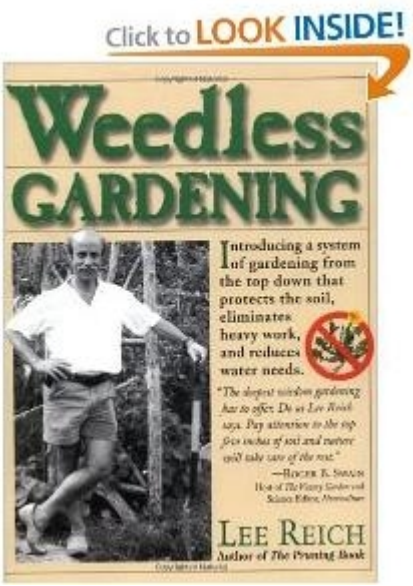
- **Crushed stone, gravel, volcanic rock. These mulches are available in a wide variety of textures, colors, and materials and are used in rock gardens, driveways, and walkways. Think carefully and make sure you really want this type of mulch before putting it in place, because these mulches are more or less permanent. It is best to underlay these mulches with landscape fabric to reduce movement of stones into the soil. Once gravel becomes mixed with the soil, it is nearly impossible to get it out. Many gravel and stone mulches are made from limestone and cannot be used around rhododendrons, mountain laurels, and other acid-loving plants. When leaves, twigs, and other debris fall into coarse rock mulches, they are difficult to remove and can make the mulch considerably less attractive.**

- **Plastics. Plastic works well for keeping weeds down and retaining soil moisture. Although it prevents water from leaving the soil, it also prevents it from entering the soil-making it unsuitable for landscape plantings that depend on rainfall for their water. Plastic is best reserved for vegetable gardens where irrigation systems can be placed under the plastic and bare spaces left between rows to allow water entry into the soil.**

- **Geotextiles. These are fabric mulches of polypropylene or polyester. They work much as plastic does, but allow water and fertilizer to enter the soil. For the best weed suppression, choose closely woven geotextiles. Generally the fabric is placed on weed-free ground and covered with another mulch, such as wood chips, to improve its appearance, keep it in place, and reduce damage to the fabric by the sun's rays. With these mulches, it is important to remove weeds as soon as they are noticed. Otherwise, roots can grow right through the fabric and become very difficult to pull.**



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Growing for profit

If you grow a large garden you will probably have lots of excess left over and this is a great way to make some extra money from your homestead.

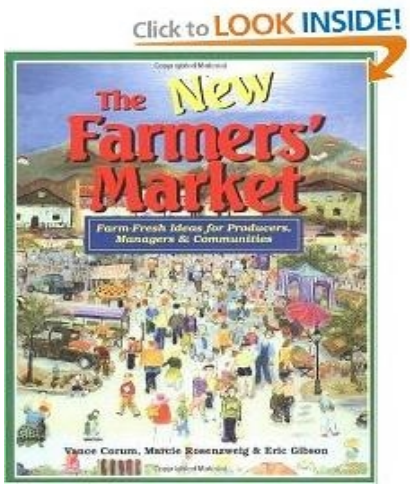
You can put up a sign in your yard saying Fresh Vegetables for Sale, take them to a farmer's market, or load up a truck or trailer with your produce and park it on any corner that gets lots of traffic.

We have many homesteaders here that sell their produce through farmer's markets or have a regular spot they park their trailers at each fall and may businesses like gas stations will let you set up on a corner of their lot for free or in trade for some produce.

Sweet Corn, Tomatoes, squash, watermelons, and pumpkins are big sellers everywhere!

If you want to supplement your income you can also grow flowers in pots, herbs, and specialty crops and there is always a market for Christmas trees if you have a lot of acreage.

City dwellers have less opportunity for gardening and love to get fresh organically grown foods so check around for a farmers market and you should have no problem finding buyers for your stuff.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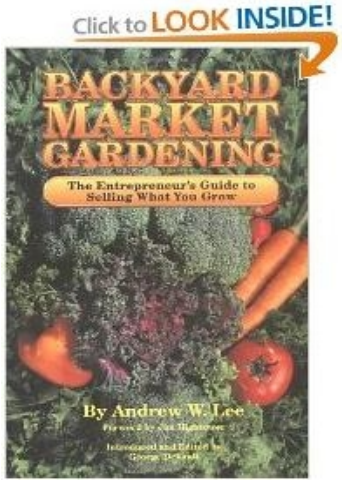
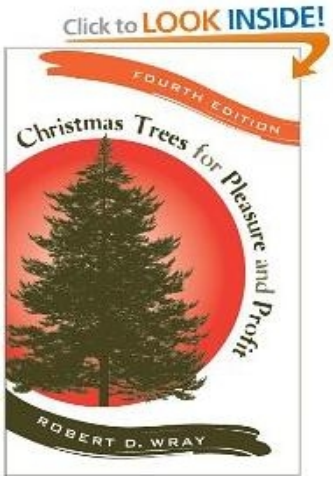
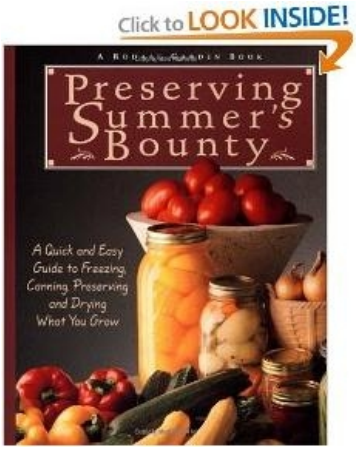
The New Farmers' Market
Farm-Fresh Ideas for Producers, Managers & Communities
Vance Corum, Marcie Rosenzweig & Eric Gibson





You should also consider how you will store your excess produce for food storage and while this book is not big enough to cover all the many food storage methods there are may books available: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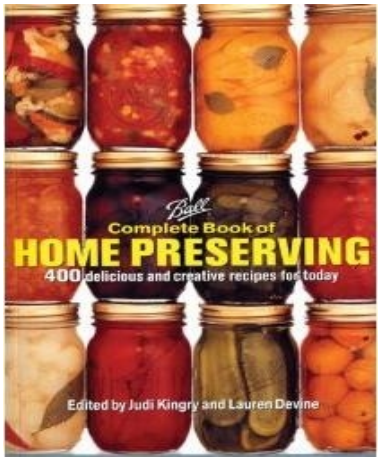
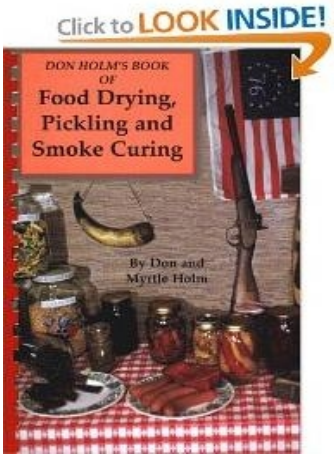
Preserving Summer's Bounty
A Quick and Easy Guide to Freezing, Canning, Preserving and Drying What You Grow


Ball
Complete Book of
HOME PRESERVING
400 delicious and creative recipes for today
Edited by Judi Kingry and Lauren Devine



SUMMARY

Well folks, I hope after reading this book you have found the information and ideas that will inspire you to create or improve your own off-grid homestead.

I have tried to include everything I think a new homesteader needs to know before setting out and hopefully by using this information it will spare you some of the dilemmas I faced when starting.

It helps a lot to have mentors and people to bounce ideas off and I have set up a Yahoo group called simple solar homesteading that has over a thousand homesteaders and off-gridder members that love to share their knowledge and learn from your experiences and you are welcome to join:

http://groups.yahoo.com/group/simplesolarhomesteading/

I enjoy sharing my experiences and I sincerely hope that you will carry on the homesteader lifestyle and share your experiences with the future generations. Our future will depend on people living a simpler life that is more in-tune with nature instead of working against it and homesteading, off-grid living, gardening, farming, and raising animals will all be a part of our future if we are to survive.

This book gives you the basic information to get you started and I have included numerous links to other peoples work, blogs, books and products so you can expand your knowledge base. I highly recommend you do your research before jumping in to an off-grid homesteader lifestyle or you may regret the decision and give up out of frustration.

Living the off-grid homesteader lifestyle is not hard but it does require a different mind set and the ability to solve problems for yourself and most homesteaders thrive on solving those problems. You will find most homesteaders have very strong opinions and independence and that style of thinking is what drove them to the homesteader lifestyle.

In closing, I just want to say thank you for buying this book and for being one of the many homesteader and off-gridder friends I have made along this journey.

May the sun always shine on your cabin!

-LaMar